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1909

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Bureau of Agriculture.

SEED AND PLANT DISTRIBUTION.

MAGUEY PLANTS.

Maguey plants will be distributed free of charge to parties requesting them, for their own use, as follows:

200 Hawaiian sucker plants, or
400 native sucker plants.

Parties wishing larger quantities will be required to pay for them at the following rates:

	Per 1,000.
Hawaiian sucker plants	₱10.00
Native sucker plants	6.00

Parties ordering plants not on the free list should send post-office money order for the amount of purchase.

Literature on the subject of maguey growing in the Philippine Islands can be secured from the Bureau of Agriculture.

KAPOK.

The Bureau of Agriculture now has a large supply of *Kapok* seedlings, which will be distributed without charge to persons making application for the same. Applications should be made at once so that the trees can be set out before the close of the present rainy season.

GUINEA GRASS.

Roots of this valuable forage plant will be furnished upon application. Guinea grass requires a rather high temperature, plenty of sunshine, and a soil that while moist is not too wet. Unless planted in a well-drained soil, the roots of this grass should not be set out until near the end of the rainy season.

MULBERRY.

A limited supply of mulberry cuttings can now be furnished to persons interested in the growing of silkworms.

Applicants for seeds or plants are requested to write name and address clearly, and to give full shipping directions for any material that can not be sent by mail. All communications should be addressed to the Director, Bureau of Agriculture, Manila, Philippine Islands.

G. E. Nesom, *Director of Agriculture.*

PLATE I. FIRST HOME OF THE BUREAU OF AGRICULTURE.

THE PHILIPPINE

Agricultural Review

VOL. II JANUARY, 1909 No. 1

EDITORIAL.

With this issue of the PHILIPPINE AGRICULTURAL REVIEW we enter upon the second year of our existence. Following the precedent established in the first number of Volume I we are devoting the first number of Volume II to the report of the Director of Agriculture for the last fiscal year. On account of the length of this report and the great variety of subjects covered, nothing else will be included in this issue. There is no necessity for additional comment as the report is self-explanatory. It may be of interest, however, to call attention to a few facts in connection with the history of the Bureau of Agriculture.

It was organized April 30, 1902, in accordance with the provisions of Act No. 261 of the Philippine Commission. The first Director was Dr. F. Lamson-Scribner, for many years Agrostologist in the Department of Agriculture, Washington. He was appointed in Washington at the request of the Philippine Commission. He arrived in Manila on April 22, 1902, and at once began the organization of this Bureau, the office of which was first located in a roomy old Spanish residence at No. 155 Calle Nozaleda. Mr. W. C. Welborn was appointed Assistant Chief, and entered upon his duties on July 13, 1903. Dr. Scribner left for the United States on leave December 20, 1903, and did not again return to duty here. Mr. Welborn was appointed Chief of the Bureau July 1, 1904. The present Director was appointed Assistant Chief in August and entered upon his duties October 10 of the same year. Under the provisions of Act No. 1407 the titles of Chief and Assistant Chief were changed to Director and Assistant Director, and reappointments made effective November 1, 1905. The resignation of Mr. Welborn and the appointment of the present Director and Assistant Director are chronicled under the heading of "Personnel" in this report.

The nature and extent of the work which the Bureau of Agriculture performs has changed very greatly during its existence. In looking back over the early records it appears that when first organized the work of the Bureau was largely devoted to the operation of a number of demonstration farms, the distribution of seeds, the collecting of information regarding the agriculture of the Islands, and the publication of literature on agricultural subjects.

The tendency at the beginning was to establish a great number of farms which should be devoted largely to demonstrating to the people better methods of conducting farming operations. There seems to have been no limit to the size of the farms established, and it is a matter of record that at one time the Murcia rice farm contained 500 acres of growing rice. In fact the farm grew to be so extensive that all experimental and demonstration work was lost sight of, and it was operated almost exclusively as a commercial enterprise. A reaction set in in the latter part of the year 1905 and several of the demonstration farms were abandoned and other farms were established which are operated as experiment stations.

The transfer to the Bureau of Agriculture of the veterinary division of the Bureau of Health and the Lamao Forest Reserve from the Bureau of Forestry, effective November 1, 1905, gave a strong impetus to the growth of this Bureau. By virtue of these transfers it received more than twice the number of classified employees then in its service. On January 1, 1907, the entire serum herd was transferred to it from the Bureau of Science. During all this time there was a constant growth in the Bureau itself. Special demands arose. The publication of the PHILIPPINE AGRICULTURAL REVIEW, the agricultural exploration and extension work, the crop-reporting service, the operation of steam plows for the reclaiming of friar lands, and the construction and maintenance of live-stock depots and quarantine stations at ports of entry in these Islands—all these have resulted in the establishing of additional lines of work and the creation of new offices.

All of this growth has been very rapid, but of such logical nature as to attract little attention. One who knew the Bureau five years ago would scarcely recognize it to-day. It has grown from a small administrative office to a large, active Bureau, the work of which covers the entire Islands. It has not yet reached its greatest usefulness, nor the warmest place in the estimation of the people. It does not rank as a first-class Bureau, but it will certainly attain that rank in the very near future, purely by the merits of its work and with the approval of the great mass of people whom it serves.

REPORT OF THE BUREAU OF AGRICULTURE FOR THE FISCAL YEAR ENDING JUNE 30, 1908.

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BUREAU OF AGRICULTURE,
Manila, August 8, 1908.

SIR: I have the honor to submit herewith my report as Director of Agriculture for the fiscal year ending June 30, 1908:

ORGANIZATION.

The organization of the Bureau of Agriculture includes the following three divisions: Administrative, plant industry, and animal industry. There has been no change in the division organization of the Bureau during the year.

ADMINISTRATIVE DIVISION.

The increasing amount of executive and clerical work, the publication of a monthly journal, and the growth of the crop-reporting service have necessitated the reorganization of this division. In February, 1908, the position of chief clerk and that of fiber expert were abolished and an Assistant to the Director was appointed as chief of the administrative division. As a result of this reorganization, the Director has been relieved of a large amount of minor executive work and the work of subordinate employees has been more clearly defined.

The administrative division now includes the following subdivisions: Clerical, agricultural extension work, crop-reporting and statistics, agricultural explorations, steam plowing and machinery investigations, publications, and library and museum.

PERSONNEL.

The Bureau force at present consists of the Director, Assistant Director, Assistant to the Director, superintendent of agricultural extension work, statistician, agricultural explorer, cashier, property clerk, machinery expert, fifteen veterinarians, five agricultural inspectors, five assistant agricultural inspectors, two stenographers, twelve clerks, three farm superintendents, three farm foremen, dairyman, stable foreman, carpenter, matadero inspector, twelve temporary employees, live-stock inspectors, messengers, and laborers at stations and farms.

The following is a complete record of changes in personnel during the year: G. E. Nesom, Assistant Director, appointed Director August 1, 1907; Charles M. Conner, appointed Assistant Director January 28, 1908; H. T. Edwards, fiber expert, appointed Assistant to the Director February 20, 1908; Pablo Tecson, appointed superintendent of agricultural extension work August 1, 1907; F. L. McVeigh, chief clerk, appointed cashier March 16, 1908; Thomas R. Flack, clerk, appointed statistician October 1, 1907; Harold Cuzner, superintendent of experiment station, appointed agricultural explorer January 1, 1908; Frank C. Gearhart appointed veterinarian August 14, 1907; S. Youngberg, appointed veterinarian August 27, 1907; James R. Love, appointed veterinarian August 27, 1907; C. G. Thomson, appointed veterinarian September 5, 1907; R. F. Knight, appointed veterinarian September 5, 1907; C. H. Leavitt, appointed veterinarian December 13, 1907; J. E. Nance, appointed veterinarian March 4, 1908; David McKibbin, jr., appointed veterinarian March 30, 1908; T. B. Boone, appointed stenographer February 20, 1908; H. N. Knight, agricultural inspector, appointed farm superintendent October 1, 1907; J. B. Thompson, agricultural inspector, appointed farm superintendent October 1, 1907; B. J. Epes, appointed clerk March 1, 1908; Oscar Franden, assistant agricultural

inspector, appointed clerk January 1, 1908; R. L. Clute, appointed agricultural inspector August 17, 1907; B. C. Ray, inoculator, appointed assistant agricultural inspector January 1, 1908; George C. Kramer, appointed assistant agricultural inspector January 28, 1908; H. A. Ireland, appointed assistant agricultural inspector February 19, 1908; A. F. Byars, appointed assistant agricultural inspector February 9, 1908; G. A. Webster, appointed clerk July 11, 1907; M. Calayag, appointed clerk September 1, 1907; E. Servando, appointed clerk July 16, 1907; J. Aragon, live-stock inspector, appointed clerk October 3, 1907; R. Dacanay, appointed clerk October 15, 1907; A. Peña, appointed clerk March 1, 1908.

Loss by resignation, W. C. Welborn, Director, resignation cabled from Washington July 18 and accepted, effective June 3, 1907; W. S. Lyon, horticulturist, September 16, 1907; H. B. Ross, farm foreman, October 5 ,1907; A. S. Ashe, disbursing officer, La Trinidad, February 20, 1908; Henry Dusdieker, assistant agricultural inspector, March 9, 1908; G. A. Webster, clerk, March 17, 1908; one employee was removed.

The year shows a gain of 22 and a loss of 6, or a net increase of 16 classified employees.

The veterinary force has been considerably increased during the year, but after providing for veterinary inspectors at Manila, Iloilo, and Cebu, only one veterinarian was available for each four provinces and important islands. This made it impossible to cover the territory as thoroughly as was desired, has necessitated responding to calls only where the outbreaks of disease appeared to be serious, and has resulted in some small outbreaks assuming a serious aspect before attention could be given to them.

Not only the veterinarians, but also our agricultural inspectors and assistant agricultural inspectors have been used in connection with the veterinary control work. Owing to the widespread prevalence of rinderpest, foot-and-mouth disease, and surra, our veterinary force is still too small to satisfactorily handle the work. The appointment of a chief veterinarian and a small increase in the veterinary force have been authorized and all vacancies will be filled at as early a date as practicable. It is probable that less difficulty will be experienced in securing veterinarians than heretofore, as a number of eligibles are now awaiting appointment.

Three new agricultural inspectors, all of whom are agricultural college graduates, arrived in Manila in January and February, 1908. The excellent services which these inspectors have rendered emphasizes the desirability of obtaining trained men for this work. During the year four agricultural inspectors have been transferred to positions as farm superintendents and four additional inspectors employed to take their

places, all of whom have been given special training in the control of animal diseases.

The clerical force has been materially enlarged during the year. This increase has been made necessary by the publication of the PHILIPPINE AGRICULTURAL REVIEW, the growth of our crop reporting and statistical work, and the large increase in record work due to enlarged field force. A number of transfers and changes have been made in the clerical force, which have resulted in considerable improvement in results accomplished. A large part of the increase in the clerical force has been in the number of native clerks employed. In general, the work of these clerks is highly satisfactory.

PUBLICATIONS.

PHILIPPINE AGRICULTURAL REVIEW.

In July, 1907, the Director of Agriculture, in recommending the publication of a monthly bulletin by this Bureau, stated as follows:

> It is essential that the farmers throughout the provinces be brought more closely in touch with the work of the Bureau of Agriculture. This fact is of particular importance in connection with our seed and plant distribution and the control of infective animal diseases. A considerable amount of the work now accomplished by means of circulars, circular letters, and correspondence could be more satisfactorily and thoroughly done through the medium of a monthly publication.
>
> We are now receiving monthly crop-service reports from more than half the municipalities of the Islands. A brief summary of these reports would be of general interest, if published regularly every month.
>
> The further development of the maguey industry, the planting of kapok trees, and other similar lines of work should be systematically and constantly kept before the people. Interest in these questions is easily aroused, but soon dies out unless constantly renewed. This kind of work can not be done thoroughly either by correspondence or by our present system of bulletins.

The first number of the PHILIPPINE AGRICULTURAL REVIEW was published in January, 1908. This journal is destined primarily to take the place of the press bulletins heretofore issued by this Bureau. It is not intended to be a journal of technical nature, but rather a serial publication on general agriculture to be used as an educational means of reaching the people of the Philippine Islands with the work of the Bureau of Agriculture. The REVIEW is issued in English and Spanish and is circulated free of charge in the Philippine Islands.

The January number of the REVIEW was devoted entirely to the annual report of the Bureau for the preceding fiscal year. Subsequent numbers have contained articles on various subjects of general agricultural interest, reports on agricultural conditions in the provinces and in other tropical countries, crop reports, statistics, etc.

On June 30, 1908, the mailing list of the REVIEW was as follows:

English, 2,555; Spanish, 5,431. This publication is sent to all provincial governors and treasurers, division superintendents of schools, municipal presidents, crop reporters, supervising teachers, agricultural colleges and experiment stations in the United States, and to a selected list of agricultural periodicals, libraries, American consuls, botanical gardens, and private individuals.

Large numbers of requests for the REVIEW have been received, and although great care has been taken in making up the mailing list, the entire Spanish editions of Nos. 1, 2, and 3 have been exhausted. The question of charging a nominal subscription price for the REVIEW is one that will have to be taken up in the near future.

BULLETINS AND CIRCULARS.

The publication and wide distribution of the PHILIPPINE AGRICULTURAL REVIEW have resulted in a largely increased demand for publications on agricultural subjects. We have issued during the year one farmers' bulletin, one press bulletin, and one printed circular. A large amount of the material formerly published in bulletins and circulars can now be published in the REVIEW. It will probably be desirable, however, to continue our series of farmers' bulletins and popular bulletins.

During the year the following publications have been issued:

Title.	Author.	Issued.	Language.
Farmers' Bulletin No. 15, Tobacco Growing in the Philippines.	G. E. Nesom	Dec. 11, 1907	English.
		Jan. 13, 1908	Spanish.
		Jan. 30, 1908	Ibanag.
		Jan. 31, 1908	Ilocano.
Press Bulletin No. 11, Seed Distribution, Need of Diversified Farming, etc.	do	Oct. 28, 1907	English.
		Dec. 11, 1907	Spanish.
Circular, Kapok	H. T. Edwards	Nov. 5, 1907	English.
		Nov. 6, 1907	Spanish.
		Jan. 7, 1908	Cebuano.
		Jan. 9, 1908	Visayan.
		Jan. 29, 1908	Ilocano.
		do	Tagalog.

PHILIPPINE AGRICULTURAL REVIEW, VOLUME I.

No. 1 (January)—*Contents:* Annual report of the Bureau of Agriculture for the fiscal year ending June 30, 1907.

No. 2 (February).—*Contents:* Forage investigations in the Philippine Islands, agricultural progress in Porto Rico, agricultural conditions in the Province of Nueva Ecija, hog cholera, school gardening in the Province of Union, commercial orange production in the Philippine Islands, the world's rice crop, range of prices of Philippine Agricultural products.

No. 3 (March).—*Contents:* Rinderpest, surra, foot-and-mouth disease, anthrax, hog cholera, glanders, hemorrhagic septicemia, ulcerative lymphangitis, methods of disinfecting.

No. 4 (April).—*Contents:* Manioc or cassava, poultry raising, La Granja Modelo, February crop reports, range of prices of Philippine agricultural products.

No. 5 (May).—*Contents:* The animal-disease problem, Bureau of Agriculture General Order No. 10, report on the animal industry of Indo-China, locusts, bud-rot of the coconut, crop-reporting service, agricultural notes from April crop reports, range of prices of Philippine agricultural products.

No. 6 (June).—*Contents:* Agriculture in the Hawaiian Islands (Part I), water and the soil, some information on silkworm culture in the Philippine Islands, agricultural opportunities in the Province of Palawan, agricultural notes, crops planted and harvested and condition of same, range of prices of Philippine agricultural products.

AGRICULTURAL EXTENSION WORK.

OUTLINE OF WORK.

On August 1, 1907, Pablo Tecson, formerly governor of the Province of Bulacan, was appointed superintendent of agricultural extension work.

The principal object in view in organizing this work was to bring the people of the Islands more closely in touch with the work of the Bureau of Agriculture. An attempt has been made to make the work practical by dealing with everyday subjects, such as the treatment of rinderpest and other animal diseases, methods of checking the spread of these diseases, the advantages of planting maguey and other crops, etc.

The superintendent of agricultural extension work has also brought to the attention of the people certain lines of work of this Bureau, such as the distributing of seeds and plants, the results obtained at our experiment stations, and the use of anti-rinderpest serum.

During the year the superintendent has made investigations in the Provinces of Batangas, Bulacan, Negros Occidental, Nueva Ecija, and Tarlac. In each of these provinces meetings were held for the purpose of explaining to the people the work of this Bureau along the lines above mentioned.

In each municipality visited, the superintendent, after having obtained information regarding soil conditions, irrigation facilities, agricultural products, condition of live stock, etc., has offered such suggestions for the improvement of agricultural conditions as the situation called for.

BATANGAS.

In September, 1907, an investigation was made in the Province of Batangas, in the course of which the towns of Santo Tomas, Tanauan, Lipa, Bauan, Taal, Lemery, Calaca, Balayan, Nasugbu, and Batangas were visited. Rinderpest was found in all of these towns, conditions being most severe at Bauan. It was noted in several of these places that the disease was first reported among animals arriving from the Visayan Islands.

The large number of people interviewed in these towns expressed appreciation of the good results obtained through inoculation with anti-rinderpest serum and appeared to be convinced of the efficacy of this

serum. Both municipal officials and owners of live stock requested that larger quantities of serum be sent to the province so that more extensive inoculations might be made.

NUEVA ECIJA.

In the month of December, 1907, an investigation was made in the Province of Nueva Ecija and the towns of Cabanatuan, Bongabon, Pantabangan, Carrancalan, Licab, Talavera, Gapan, San Antonio, Aliaga, San Jose, San Juan de Guimba, and Cuyapo were visited. In practically all of the towns visited in this province it was found that the rice crop had suffered severely from drought, the shortage being in some places from 70 to 90 per cent.

No diseases among live stock were found.

In many of the towns visited, crops such as coconuts, cacao, coffee, kapok, maguey, and cotton might be advantageously grown. This fact was brought to the attention of the farmers and property owners throughout the province and all were advised to encourage the cultivation of these crops.

BULACAN.

During the month of January, 1908, an investigation was made of agricultural conditions in this province, which, like Nueva Ecija, suffered great loss in the rice crop by reason of drought.

This investigation was made especially for the purpose of determining the irrigation facilities in the province. It was recommended that a canal be opened in the Rio Grande of Pampanga for the purpose of irrigating rice lands in the municipalities of Hagonoy and Calumpit, and it was estimated that if such a canal were opened the production of rice in these towns could be increased by at least 20 per cent.

OCCIDENTAL NEGROS.

This investigation was made during the month of February, 1908. Among the towns visited were Pontevedra, Jinigaran, Binalbagan, Jimamaylan, Cabancalan, Ilog, Isabela, and La Carlota. This investigation was made for the special purpose of learning the existing conditions with regard to the prevalence of rinderpest and of furnishing the people with information regarding the use of anti-rinderpest serum.

In all of the municipalities visited, meetings were held and the people were told of the successful results obtained in other provinces in fighting rinderpest by means of inoculation and quarantine. The impression made on the people was most satisfactory, and it is believed that a large number of the "hacenderos" of this province are now convinced of the value of this serum. Many of them requested the superintendent of agricultural extension work to make arrangements for the inoculation of their animals and offered to pay the cost of same.

TARLAC.

This investigation was made in the month of May, 1908. Among the towns visited were Victoria, Pura, Paniqui, Camiling, Moncada, Capas, Concepcion, and Bamban.

The principal products in this province are rice, sugar cane, and corn; coconuts, ylang-ylang, and maguey are cultivated to a limited extent. The amount of rice harvested last December and January was small, the shortage being estimated at about 50 per cent, due both to drought and excessive rain. Corn and sugar cane were found to be doing well with prospects of a considerable crop.

Little disease among live stock was reported, there being only a few cases of foot-and-mouth disease and rinderpest.

CROP REPORTING AND STATISTICS.

STATUS OF WORK.

The crop reporting and statistical work of the Bureau was organized during the latter part of 1906. The proposed work, as stated in our last annual report, was—

> To obtain regular and reliable information relative to crops and live stock in all parts of the Islands, to summarize and tabulate this information so that it may be in the highest degree useful and available, and to publish such part of the information received as may seem desirable.

At the close of the last fiscal year on June 30, 1907, a corps of 370 municipal reporters had been organized and 1,628 monthly crop reports had been received. No attempt had been made to tabulate any statistics or to publish any crop reporting material.

During the present year the number of crop reporters has been substantially increased. The quality and regularity of the monthly reports have been improved. The large amount of data received has been tabulated and made available for ready reference, and the regular publication of crop reporting and statistical material in the PHILIPPINE AGRICULTURAL REVIEW has been effected.

During the first part of the present fiscal year Mr. J. B. Thompson was acting statistician. On October 1, 1907, Mr. T. R. Flack was appointed statistician and performed the duties pertaining to this office during the remainder of the year.

COMPILATION OF DATA.

Data of the kind received in crop reports, in order to be of any practical value, must be so tabulated and arranged as to be available on short notice. The necessary forms for tabulation were received early in the year and within a period of about two months the work of tabulating the statistics received was brought up to date.

PUBLICATION OF CROP REPORTS.

The publication of data received is an essential part of the crop reporting service, and one of the objects in view in publishing the PHILIPPINE AGRICULTURAL REVIEW was to furnish a means of disseminating among the people the information obtained through the medium of the crop reporting service. There is now published in each number of the REVIEW a tabulated statement showing the range of prices of the more important Philippine crops. In the April number of the REVIEW, in order to give the people a clear idea of the crop reporting work, we published a brief summary showing weather conditions, crops planted and harvested, etc., during the month of February, in all of the municipalities from which crop reports had been received. Notes of a similar nature, but in a more condensed form, were published in the May number of the REVIEW. The June number contained brief notes on agricultural conditions and also a tabulated statement showing the crops planted and harvested and the condition of growing crops during the month of May.

QUALITY OF THE REPORTS.

There has been considerable improvement during the year in the quality of the crop reports received. It is believed that the publication of these reports will result in still further improvement, for the following reasons: When a subscriber of the REVIEW reads the crop reports published therein and notes that the statements relative to crops in his municipality are not correct, it is probable that in many cases he will consult with the Bureau's correspondent in that municipality and offer suggestions as to how reports may be improved. Furthermore, crop reporters themselves, when they learn that their reports are being published and read by persons in their own municipality, will endeavor to submit reports as free from errors as possible.

SPECIAL REPORTS.

Accompanying the regular monthly report blanks, there have been sent out at frequent intervals blank forms on special subjects, such as the mulberry, agricultural machinery, the mango, etc., to be filled out and returned by the reporters. These special reports have been compiled and furnish much valuable information.

RECEIPT OF REPORTS.

One drawback to this service is the infrequency of mail communications between Manila and many places in the Islands, some places receiving mail but once a month and others only twice a month. It often happens therefore, that reports are received several weeks or a

month late. This difficulty has been overcome to some extent by sending out report blanks to the more distant provinces a considerable period in advance of those provinces which are located near Manila.

SUCCESS OF SERVICE.

The practicability of organizing and carrying on a crop-reporting service in the Philippine Islands has been fully demonstrated. The majority of the municipal reporters have never done any work of this character before, and various other obstacles of more or less serious nature have had to be overcome. Considering these facts, the results obtained have been very satisfactory.

The municipal elections which occurred in the early part of the year seriously interfered with the crop reporting work. The majority of our crop reporters are municipal presidents, many of whom were not reëlected. In a large number of cases the ex-presidents failed to inform their successors in regard to the crop reporting work, and although the Bureau continued to send blank forms every month they were not filled in and returned as formerly. It was some time before the true state of affairs became apparent, and then steps were taken to immediately remedy the difficulty. Letters were sent to the municipalities from which reports were not being received, explaining the nature of the crop reporting service and asking for the hearty coöperation of the officials. Letters were also sent to the provincial governors and division superintendents of schools, requesting that they correspond with those municipalities from which reports were not being received, with a view to securing persons to act as crop reporters. It is gratifying to note that correspondents have been obtained in many of these municipalities, and a larger number of reports are now being received than during any previous time since the organization of the crop-reporting service.

AGRICULTURAL EXPLORATIONS.

It has been found necessary to detail Mr. Harold Cuzner, agricultural explorer, to the work of seed and plant introduction and distribution during the greater part of the year. For this reason, exploration work has been limited to short trips through the provinces near Manila.

INVESTIGATIONS IN THE PROVINCE OF BATANGAS.

On December 12, 1907, an inspection trip was made through the Provinces of La Laguna and Batangas. On this trip special attention was paid to leguminous plants that might be useful either for food or for the production of forage. Seeds of *Atylosia scarabaeoides, Dolichas falcatus, Uraria lagopdivide,* and *Phaseolus lunatus* were collected, beside several varieties of patani. Of these the *Alysicarpus vaginalis* (mani manihan) is probably the most promising because it is readily

eaten by animals and is often found making a considerable growth in cogon. The seed, however, seems to be difficult to germinate, and only a few plants were obtained from the seed collected.

The orange districts in the neighborhood of Tanauan were visited and many of the trees were found to be suffering from the attack of an insect which was working under the bark. In this district oranges are propagated from seed, with little or no attempt at selection. Cultivation, pruning, and manuring of the trees are entirely neglected. A very bad result of the lack of pruning is that the dead wood becomes infected with white ants and other borers that work their way down to the healthy wood. It was stated by several owners of orange groves that when the trees are in full bearing they yield from 2,000 to 3,000 fruits, valued at ₱4 to ₱5 per thousand. Seedling orange trees are sold in the neighborhood at ₱10 per thousand and many small plantations are being put out.

At a barrio near San Jose, a plantation of Liberian coffee was seen, and although the trees had received little or no attention and were planted very close, they seemed healthy and were bearing a good crop of berries. This variety of coffee, however, does not seem to find much favor on acount of the difficulty in removing the hull. These coffee trees were said to be about fifteen years old and to have been in bearing for the last ten years.

INVESTIGATION OF SUGAR-CANE DISEASE.

During the month of April, 1907, the agricultural explorer, in company with Dr. Robinson, of the Bureau of Science, made a trip to Santa Rosa, La Laguna, to investigate a sugar-cane disease reported from that neighborhood. The field in question was a crop of rattoons and almost every plant was found to be badly infected with "smut" (*Ustilago saccharii*). Owing to the nature of this disease there is no remedy that can be applied to the infected plants. It was recommended that all the infected plants be cut and burned in order to prevent a spread of the infection, also that the land be planted with another crop in order to get rid of spores that were in the soil. The owner agreed to do this and a sufficient quantity of Carolina golden rice with which to sow the field was furnished him.

An investigation of the sugar-cane districts between Santa Rosa and Los Baños was then made to determine the extent of the disease, but no other infected fields were found.

In order to find out whether this disease existed in other localities, a circular letter was sent out to a large number of correspondents of the Bureau, giving a description of the diseased plants, and inquiring as to the existence of the disease in each locality. The reports received, with two exceptions, one from the town of Sampaloc, Tayabas, and the other from Manapla, Occidental Negros, were negative. The disease reported

from Tayabas, on further investigation, proved to be of entirely different nature and not at all dangerous. That reported from Occidental Negros was said to be very limited in extent, affecting only one plant in one thousand. If it exists at all, however, in this important sugar producing province, it should be carefully watched as in time it is liable to become epidemic.

STEAM PLOWING AND MACHINERY INVESTIGATIONS.

PLOWS.

The extra heavy V-shaped plows mentioned in the last annual report have been successful in turning all kinds of land, no matter how hard or foul with grass and weeds. Owing to the fact that these plows throw the dirt in both directions, thus leaving a ridge and a furrow at each passage, necessitating considerable work with disc harrows to level the land, this type of plow was abandoned temporarily and another plow constructed on the general plan of the ordinary disc plow purchased in the market. This new plow, however, is made of extra-heavy material and so reinforced as to withstand the strain put upon it in cutting cogon sod, the roots of young trees, etc.

This plow was a decided success, doing good work on moist land as well as on cogon sod or old land. It will replow the land any number of times, a thing which the V-shaped plow mentioned above will not do, but it will not plow hard, dry land as well as the V-shaped plow. It leaves the land level and in good condition, and if a 5-foot disc harrow is hitched on behind the plow, work equal to two plowings can be done at one passage of the engine.

The ordinary disc plow manufactured in the United States for use on sod land, is not adapted to work in these Islands, owing to its lightness of construction. It is therefore recommended that the attention of plow manufacturers be called to the construction and work of this plow and some reliable firm induced to take up the manufacture of the same. If this is done, when plows are ordered hereafter for work in these Islands we shall have some assurance of their success, with the many objections with regard to breakage, etc., removed.

ENGINES.

This Bureau now has on hand one 35-horsepower engine, one 18-horsepower engine, one 22-horsepower engine, and one 22-horsepower Hart-Parr petroleum-burning engine.

As mentioned in our last report, the friar lands, as they now stand, are not well adapted to the use of steam plowing engines, because of the fact that the fields are small, separated as a rule by ditches or embankments, and grown up with cogon, talahib, and trees of various kinds. The rice dikes and old cane ridges also interfere materially with

the operation of the steam engine, as in crossing these it is necessary to reduce speed. The ground being uneven it is frequently necessary to plow in small patches, owing to the fact that a part of the ground may be too wet while the remainder of the field is in proper condition for plowing. These small fields necessitate frequent turning of the engine which also consumes time.

OPERATIONS.

The 35-horsepower engine and 12-disk plow and the 18-horsepower engine and 6-disk plow were taken to the Santa Rosa Estate on October 22, 1907, and used there until February 8, 1908, at which time the plowing operations ceased on account of the opening of the sugar grinding season.

The following is a detailed statement of the work performed by the 35-horsepower engine and 12-disk plow:

Actual time worked ... days	28
Amount of land plowed ... hectares	72.2389
Value of 28.3 tons of coal at ₱20 per ton	₱566.66
Wages of one engineer and two firemen	227.64
Repairs and oil (actual days worked)	112.00
Total cost	906.30
Average area plowed per day ... hectares	2.58
Average amount of coal consumed per day ... tons	1.01
Cost of fuel per hectare	₱7.84
Cost of wages, oil, and repairs per hectare	4.70
Total cost per hectare	12.54

To this must be added the wages of three laborers furnished by the land owner.

The fact that only twenty-eight days of actual work was done with this engine and plow was largely due to weather conditions.

The following is a record of the 18-horsepower engine and 6-disk plow during the same period:

Actual time worked ... days	37.50
Amount of land plowed ... hectares	67.50
Value of 19 tons of coal, at ₱20 per ton	₱380.00
Wages of one engineer and two firemen	277.50
Repairs and oil (estimated)	90.00
Total cost	747.50
Average area plowed per day ... hectares	1.72
Average amount of coal consumed per day ... ton	.50
Cost of fuel per hectare	₱5.80
Cost of wages, oil and repairs per hectare	5.44
Total cost per hectare	11.24

To this must be added the wages of one laborer furnished by the land owner.

To give an idea of what the 18-horsepower engine and 6-disk plow can do on a straight run of five days, the following tabulated statement is submitted:

Amount of land plowed....................hectares....	19
Wages of engineer and two firemen....................	₱39.50
Wages of six laborers, pumping water and cutting wood, at ₱.60 per day for five days....................	18.00
Oil, at ₱1 per day....................	5.00
Total cost	62.50
Average amount of land plowed per day....................hectares....	3.80
Average cost per hectare....................	₱3.25

It will be noticed that the average area plowed per day by the 35-horsepower engine and 12-disk plow was much greater than the 18-horsepower and 6-disk plow, but that the cost of plowing is less in the case of the 18-horsepower engine and 6-disk plow, the greater cost of the 35-horsepower engine and 12-disk plow being due largely to the fact that more coal was consumed in operating. If wood could have been substituted for coal and furnished by the land owner, the cost of plowing would have been about the same in both cases. It is believed from the figures given in the last table that the smaller engine and plow will do the work at much less cost, provided many obstructions are removed, as will be mentioned later on in this report.

The cost of plowing shown in the last table could have been materially reduced if water could have been secured near at hand. It was necessary in this case to employ three laborers to pump water from a deep well.

Much of the variation in the cost of plowing, as given from time to time, is due to the different conditions with which the plows have to contend in the different fields plowed. Some fields will be comparatively large, level and well suited to steam plowing, while others will be small, difficult to reach, probably wet in places, and perhaps covered with rice dikes or old cane ridges which, in many cases, run at right angles to the direction of the plow, necessitating a reduction in speed and a waste of valuable time. Furthermore, the fields may be filled with ant mounds, hidden stumps, small trees, etc., all of which should be removed before taking the plow to the field.

The heavy engine is much more expensive to move from field to field, its excessive weight causing it to sink in soft places. The large plow will also come in contact with more stumps and roots, causing a greater percentage of breakage than the small one. This breakage is charged to the land plowed under the head of "repairs." Rough land causes more damage to the heavy engine owing to the fact that the bolts loosen on account of the jar in passing over the obstructions.

The smaller engine is much more economical due to the ease with which it can be turned around in small fields.

The farmer who owns a steam plow has a decided advantage over the Government in being able to use his labor at other work on the farm when not employed in steam plowing. The Government is required to pay its men during bad weather and while the engine is laid up on account of breakages, etc.

The 22-horsepower engine and the 8-disk V-shaped plow were taken to the Imus Estate the latter part of March, but owing to the lateness of the season and to the fact that the land had not been properly prepared, very little was accomplished.

The 22-horsepower Hart-Parr petroleum-burning engine was taken to the Alabang stock farm the latter part of May. This being a new engine it was necessary to do some experimenting before any steady work could be undertaken. It was, therefore, used for hauling and plowing for several days; the rains, however, interfered with any extensive operations. A short test was made of the amount of fuel consumed, which seemed to show that it consumed about 3½ gallons of petroleum per hour. The test was satisfactory in every way, both as to hauling and plowing. While this engine weighs 9½ tons, yet it is very easy to handle on ordinary sod land. All indications point to this as the coming traction engine for use in those districts where fuel and water are difficult to obtain.

PREPARATION OF FIELDS.

Many farmers desiring to have steam plowing done still neglect to have the fields properly prepared before asking that the plows be sent to their farms. The labor furnished by the land owner to supply fuel and water for the engine is, in many cases, very unsatisfactory.

Many farmers seem to think that the plow is a stump puller and instead of grubbing up trees 10 inches below the surface of the ground, as they have been instructed to do, will cut them off even with the surface. The engineer is unable to see these stumps and broken disks are the result, causing delay in securing castings from Manila, to say nothing of the expense of same. Some farmers after six months' notice wait until the plow arrives before they begin grubbing stumps and trees, leveling ant mounds, etc. It is only fair to say, however, that others give every assistance possible in the work by having the land properly prepared and fuel on the ground.

While it is not the policy of this Bureau to recommend burning any organic matter off the soil, we find it necessary to have the tall grass which grows on these semiwild lands burned, or otherwise removed, in order that the engineer may see the ant mounds, ditches, and other uneven places in the ground sufficiently in advance to avoid them.

Possibly the easiest way to do this is to pass a roller over it at the end of the rainy season, crushing the grass down so that it burns completely when fired.

FUEL.

In regard to fuel, it is recommended that no more coal be used in steam-plow work, and that every farmer who desires plowing done have wood cut at least six months in advance of the plowing season. In many cases "madre de cacao" can be secured in close proximity to the field and if this wood is cut a sufficient length of time before the plowing season it makes a better and very much cheaper fuel than coal. Its use will result in a saving of cost in plowing from ₱4 to ₱6 per hectare.

FIBER MACHINERY.

The Pioneer maguey machine referred to in our last report was experimented with and five improvements made on this machine. After these improvements were made a number of experimental tests were made in cleaning fiber, the results of which were fairly successful. The machine cleaned an excellent quality of fiber, but the quantity obtained in a given length of time was not entirely satisfactory. This machine was later sent to Vigan in the Province of Ilocos Sur where it was installed in the Trade School. The following report relative to the use of this machine in Vigan has been furnished by the division superintendent of schools in Ilocos Sur.

The maguey machine was sent to Vigan last January. It was set up and began work on the 17th of that month. It continued work until the 19th of February, ultimo. During this period the machine ran 140 hours on twenty-two different days and stripped 117,000 leaves, an average of 835 leaves per hour. This resulted in 1,572 pounds of clean fiber. The labor exclusive of the man in charge amounted to ₱42.45 and the fuel for the engine cost ₱59. The per cent of fiber obtained is 4, and the waste amounted to 95 per cent.

The principal maguey growers of Ilocos Sur brought leaves to be stripped and saw the machine in operation. It demonstrated to them that a machine can strip maguey and strip it successfully. In this respect the experiment has been a success. But the capacity of the machine is too small to make it a commercial success. In this respect the machine has been a failure.

One of the smaller Prieto fiber-cleaning machines has been received from the United States but has not yet been put into operation.

CORN GRINDING.

A Kelly duplex feed grinding mill ordered by the Bureau has been at the Singalong experiment station during the year. This mill has a capacity for grinding about 18 cavans of ear corn per hour and is operated with an 8-horsepower Altman-Taylor portable steam engine. We have ground a total of 170,538 pounds of corn, sending some to the stock farms at Alabang and Trinidad, and some to the serum

laboratory at San Lazaro. A test to determine the cost of grinding ear corn with this mill was made on June 1, 1908, with the following results:

Time in operation, 3 hours, 5 minutes.
Weight of corn and cob meal, 6,137 pounds.
Labor used:

Four men, at 10 centavos per hour	₱1.23
Two men, at 12½ centavos per hour	.77
Coal used, 436 pounds at 80 centavos per hundredweight	3.48
Total expense of grinding 6,137 pounds	5.48

The cost, as shown by this test, without figuring interest on capital invested and wear of machinery, was a little more than 9 cents per hundredweight. The conditions under which this test was made were, however, very favorable, and the run made was an unusually good one.

PUMP AND BOILER.

An upright boiler and a steam pump have been installed at the Alabang stock farm to pump water for irrigation and stock use; also, the steam hay press was taken to the same station and used in baling straw purchased for the use of the stock during the rainy season.

SMALL PLOWS.

An assortment of small plows cutting from 5 to 6½ inches was purchased with a view of trying them in the various kinds of soils found in the Islands, and the plows found to work well in certain soils will be recommended to firms importing implements. There is a large demand for good, small plows which one vaca or carabao can pull. The kinds that have been imported heretofore have not been adapted to conditions existing here. When the right kinds of plows are imported they will find ready sale and do a much better class of work than the native plow now in general use in the Islands.

DIVISION OF PLANT INDUSTRY.

This division includes all general plant investigation, seed distribution, laboratory and field test of seeds and the work at the experiment stations located as follows:

Singalong.—Located in the southern part of Manila on sandy soil at sea level.

Baguio.—Located at Baguio, Benguet Province, at an elevation of 1,500 meters on drift soil, rather poor in plant food.

There are also two substations located on the west side of the mountain range between Baguio and sea level, for purpose of testing crops at various altitudes.

Lamao.—Located on Lamao forest reserve in Bataan Province. This

station is also at sea level. The soil is mixed sand and clay of average fertility.

La Granja modela.—This is the old Spanish experiment station near La Carlota, Occidental Negros, and is devoted largely to growing cane.

Lipa.—Located near Lipa, Batangas Province, in the coffee district. Nothing but coffee is grown at this station.

PLANT INVESTIGATIONS.

ABACÁ.

Work during the past year with this fibrous plant has been limited to the propagation from seeds and owing to the difficulties experienced in securing good, viable seed for planting, results have not been especially favorable. Some plantings failed entirely. One lot, coming to us under the variety name of Large Sorsogon, germinated nicely, but proved to be not abacá but "wild banana," a practically worthless species found in waste places and without cultivation in many parts of the hemp-producing districts.

The two small plantings at Singalong that proved successful have furnished about 1,500 seedlings which are now growing nicely under shade. Plants from the first planting made in July, 1907, stand from 1.3 meters to 2 meters in height, the measurements being taken to the top of the erect growing leaves. There is now an average of more than three suckers springing from the roots of these plants.

"Abacá blanca" is the name of a variety coming from Casiguran, Sorsogon, and planted in the seed bed November 6, 1907. These were grown under shade and on March 26, 1908, while not nearly so large as those from the early planting, were beginning to sucker.

A similar test was made at Lamao station, where, after growing the plants under shade until they were from 18 to 24 centimeters high, they were transplanted to the open field. About 20 per cent of these transplanted plants died from the effect of the exposure. It was noticed that the smaller plants suffered more than the larger ones. They all made slow growth for the first two months, after which growth was more vigorous and the plants are now very promising.

About 3,000 plants are available for distribution from this planting.

At La Granja, Occidental Negros, plantings were made in a similar way and with the same kind of seed. From 0.75 kilogram of seed 2,000 plants are available for distribution.

An attempt was also made at this station to grow abacá from seed by sowing it between rows of growing cane, but it was found that when the cane was removed the young plants died from exposure to the sun.

From experiments so far it is deemed advisable that in case it is desired to grow abacá from seed that a shade be constructed of bamboo

so as to give about one-half shade to the plants growing under it. With a thoroughly prepared seed bed and with proper attention as to watering, etc., plants can be grown very successfully in this way and be ready for transplanting in from four to six months.

Considerable difficulty has been experienced in securing seed that would germinate. Germination tests of various samples of seed received range from 2 to 80 per cent. Care should be taken not to secure seed from unripe plants as the per cent of germination is usually very low.

MAGUEY.

Work with maguey during the past year has been confined largely to the distribution of sucker and pole plants, both native and Hawaiian. Interest in this crop continues unabated and requests for plants have ranged from one to thirty thousand from individuals and governors of provinces. More than two-thirds of the plants distributed have been what is known as pole plants.

About 67,000 of these pole plants, arriving from Honolulu in a very dry, wilted condition, were planted in a nursery at Singalong in July, 1907, in order to ascertain the probable growth of these plants during the first year. These plants were set in rows 50 centimeters apart with 24 centimeters between plants in the row. They occupied a total area of 7,000 square meters. On June 30, 1908, many of these plants had reached the height of from 42 to 66 centimeters. Some are producing suckers. These plants have been distributed as the other plants.

The total number of maguey plants distributed during the year is given in the table of seed distribution elsewhere in this report.

Three hundred and fifty thousand native pole plants were grown in nursery at the Lamao forest reserve. A large per cent of these plants have been distributed during the past year, but we still have on hand for distribution at this place something over 150,000 plants.

A field containing 2.5 hectares was planted in both native and Hawaiian maguey at Lamao station in order to test the feasibility of planting maguey among the stumps after the trees and brush had been removed by cutting and burning. These plants have made normal growth, some Hawaiian plants having leaves 1.3 meters long, but require considerable expense in cutting down the brush and weeds each season.

The field of 2 hectares of Hawaiian maguey, planted on the high, rolling land at La Granja, Occidental Negros, October 27, 1906, has developed very uniformly, producing leaves 1 meter long, and in another year will be ready for cleaning tests. It is estimated that 10,000 sucker plants can be obtained from this field now for distribution. The area of maguey is gradually being extended at this farm.

The 336,000 native pole plants from Ilocos Norte, set in nursery at La Granja on November 6, 1907, are now ready for distribution.

KAPOK.

During the past year kapok seed has been planted at Singalong, Lamao, and La Granja for the purpose of securing young trees for distribution. There are now available for distribution at the various experiment stations two and one-half million seedling trees. Although we have advertised that these trees are available for distribution very few requests have been received for seedlings.

Experiments have been begun at Lamao and Alabang to show the relative value of the various methods of securing kapok trees, namely, from the seedlings and truncheons. As it will be some years before these trees will come into bearing, no report can be made as to the probable value of either method.

Data have been collected by representatives of the Bureau in various provinces on the yield of kapok trees, both wild and cultivated. Very few reports show that the trees are cultivated to any extent at all. Most of the reports are on trees growing either wild or in fence rows. A total of 448 trees have been reported upon, but as the figures cover a period of only one year the work will be continued for at least two years longer.

RUBBER.

Four species of rubber plants are in cultivation at Singalong. They are *Hevea brasiliensis, Castilloa elastica, Manihot glaziovii,* and *Criptostagia grandiflora,* the last-mentioned species being a wild native vine. Four *Hevea brasilienses,* or Para rubber seedlings, planted almost four years ago were measured on June 2, 1908. The circumferences were taken 1 meter above the ground. Girth measurements are given in centimeters and height in meters.

	Circumference (centimeters).	Height (meters).
No. 1	25	6.0
No. 2	28	7.0
No. 3	27	6.6
No. 4	31	7.0

Five seedlings of *Castilloa elastica* planted at the same time were also measured on the above date in the same manner as the Para rubber and showed the following dimensions:

	Circumference (centimeters).	Height (meters).
No. 1	37	5.0
No. 2	36	4.6
No. 3	45	5.3
No. 4	33	4.0
No. 5:		
(1)	28	4.0
(2)	30	4.0

These trees have not rooted well and consequently have blown down during heavy typhoons. This is not surprising, however, when it is remembered that this rubber requires certain elevation above sea level and that the elevation at which it is growing here is about 1 meter. During the past year these trees have produced seed.

About 100 trees of Ceara rubber, ranging in height from 10 to 12 meters, now growing at La Granja experiment station in Occidental Negros, are producing seeds in large quantities. Many thousand seeds have been distributed to persons interested in this species of rubber plant.

The area is being extended by planting truncheons and seed, so that in a short time sufficient area will be secured to make a test of this rubber on a commercial basis.

FIELD CROPS.

CORN.

Seed of a native white variety was obtained from Batangas and planted at Singalong January 6, 1908, with the object of determining its yield of green fodder. The seed proved weak, and on January 22 only about 20 per cent had sprouted. Replanting was resorted to and a fair stand obtained. The stalks grew quickly and attained a height of about 2.15 meters. It made excellent fodder, many small ears adding to its value. The ears filled out fairly well, but were seriously damaged by a small cut-worm (lepidopterous) which resembles the cotton boll-worm. The crop was cut March 18 and amounted to 2,492 kilos, equivalent to 14,459 kilos per hectare.

A small planting of Longfellow variety, seed of which was introduced from the United States, proved a failure. Stalk development was very weak and the small amount of corn produced was light, chaffy, and of very poor quality.

Seed of the large Mexican June corn recently introduced from the United States and sent to this station for trial was planted and the corn is now growing nicely.

At Lamao a trial test was made of "Longfellow" in comparison with native corn grown in the vicinity of the Lamao forest reserve. The "Longfellow" came in flower some two weeks in advance of the native variety and ripened in seventy-two days. The yield was comparatively small but promising. At this station a test was also made of a variety of sweet corn known as "Sanford." This variety does not have the appearance of sweet corn, but seems to carry more sugar than the ordinary field corn and is quite valuable for table use. The ears are quite long and cylindrical, filling out well toward the end. This is perhaps the most promising variety of sweet corn tested at this station so far. It matured in seventy-one days. Enough seed was saved of this to plant quite a large area the coming season, in order that we may have seed for distribution.

A test was made of early Crosby sweet corn at La Carlota to determine its value as table corn. The development of the corn was very poor and no ears of sufficient size to be of use were produced. This is probably due to the fact that sweet corn is native to cold climate and it does not thrive where the temperature is high during the early period of growth.

A test of early Crosby made at Sablan, a substation of Baguio, located at an elevation of 600 meters, gave excellent results. The corn grown was in every way equal to corn grown in the United States.

ALFALFA.

Small plats, 2 by 10 meters, of English and Turkestan alfalfa were sown at Singalong in December, 1907, and have produced two good cuttings. Ten pounds of inoculated soil, which had been introduced from the United States, was worked into the ground at the time of seeding and resulted in the development of an abundance of large nodules upon the roots of the young plants. Growth was rapid, but while the plants increased in height they showed a decided weakness of the stem, a defect which caused much of the first crop to lodge. Blossoms were very sparsely borne. The number of plants in bloom at any one time did not exceed 3 per cent of the stand, though cutting was delayed more than eight weeks after the first flowers appeared. The few seeds that set failed to mature. Conclusions as to the results of the trial can not be drawn until the effects of wet weather upon the crop are learned. Previous experiments have given considerable encouragement during the dry period, but utterly failed upon the advent of wet weather.

Alfalfa has been grown at Baguio for some years in an experimental way, using seed from various sources. Although no inoculation was given to the soil the plants produced a few nodules, but the results as a whole have not been promising. The plants would grow well for short periods and then seem to die out. A few blooms have appeared on the plants, but so far no seeds have been secured.

A small plat was planted in alfalfa at Alabang on stiff clay soil, but the plants did not seem to thrive well, although the land was inoculated with soil obtained from California. The plants soon died out and the plat was overgrown with grass and weeds.

SUNN HEMP.

Tests made with this legume (*Crotalaria juncia*) have developed some interesting facts. Plants grown from a few seeds planted in drills October 23, 1907, attracted attention on account of their prolific seeding habits, and a more extensive planting was planned.

On February 4, 1908, a plat measuring 364.5 square meters was planted in rows 0.5 of a meter apart. The crop was produced with just one hoeing and one irrigation which, from later appearances, was unnecessary.

Cutting was completed May 20, 1908, and a yield of seed secured equal to 2,395 kilos of seed per hectare.

A small quantity of seed was run through a corn-grinding mill and the product screened through a close-meshed wire screen, thus separating the smaller particles or bean meal from the larger, or bean hulls. The bean meal constitutes 70 per cent and the bean hulls 30 per cent of the total weight. Samples furnished the Bureau of Science showed the following analysis:

Contents.	Meal (per cent).	Hulls (per cent).
Moisture	9.66	12.42
Ash	6.72	4.88
Protein	43.86	9.81
Nitrogen-free extract	28.06	54.52
Crude fiber	7.86	17.37
Ether extract	3.84	1.00

Some of this ground seed was fed to stock in small quantities, but tests have not been sufficiently extensive to justify any positive assertions in regard to its possibilities as a stock feed. Horses did not seem to relish it when fed alone, but when mixed with an equal part of oats or Indian crushed feed, they ate it fairly well. Cattle ate the bean meal greedily at first but seemed to tire of it in two or three feedings. Bean meal was also fed to hogs at various times and was always eaten readily, but owing to a lack of feed in sufficient quantities no systematic feeding tests have been made.

COWPEAS.

The so-called Venezuela black bean has been grown again at Singalong during the past year and has produced a heavy yield of seed and a rank growth of vine. The planting was made on January 13 and seeds first ripened March 30, just eleven weeks after planting. A native "sitao," or cowpea, was also planted, but it proved less productive, both of seed and vine growth, than the Venezuela black bean. Both cowpeas have been attacked by aphids which did much damage and at one time threatened to ruin the crop.

VELVET BEANS.

A small plat of the Lyon velvet bean was planted at Singalong on January 11, 1908, and five months later a crop of seed yielding at the rate of 2,200 kilos per hectare was harvested. These beans are inclosed in a thick fleshy pod which, upon reaching maturity, shrivels up and becomes very tough and leathery. A separation of the beans from the pods is effected with difficulty without machinery. In our work with this bean during the present year the crop did not mature until the rains began and many beans decayed and were lost from contact with

the wet ground. To eliminate dangers from loss through these causes, an earlier season of planting is recommended.

An uncultivated black velvet bean was planted at the same time and in the same manner as the Lyon bean. In vine growth it is decidedly outstripped by the Lyon bean, but after six months' growth it has failed to set a single flower.

The Florida velvet bean has been used at Alabang as a forage crop only. No attempt has been made to obtain a yield of beans. It has been grown with either sorghum or teosinte in order to make a mixed forage for feeding the live stock. It grows fairly well on this stiff soil and makes a greater amount of green forage per acre than any other leguminous plant.

NATIVE LEGUMES.

A number of native legumes have been collected and tested at Singalong to ascertain their value for forage or cover crops. Those most promising are *Tephrosia luzonensis, Indigofera hirsuta, Phaseolus semierectus* L., *Crotalaria incana* and *Abyscicarpus vaginalis.* All of these were found growing in an uncultivated state.

I. hirsuta, P. semierectus L., and *O. incana* were not eaten by horses and cattle. *T. luzonensis* was eaten rather indifferently by both horses and cattle. A marked improvement in the vigor and robustness of this latter plant has been brought about by cultivation. *A. vaginalis* or mani-mani, is the most promising of all the species included in the test. All classes of live stock eat it readily. Growing wild it springs up among cogon or other weeds and attains a height of from 0.75 to 1 meter. At Singalong it has not shown an upright habit of growth, but planted on clean ground it has taken the form of a trailing plant with recumbent stems. It is not only resistant to long continued drought, but will live through excessively wet periods even in poorly drained locations where alfalfa, for example, would undoubtedly be lost. This little plant promises well as a pasture crop and will probably prove of considerable agricultural value if introduced into general cultivation. Seeds in quantities sufficient for making more extensive plantings of this legume are now available and it is hoped to continue the work during the coming year.

GUINEA GRASS.

Prior to January 1, 1908, field space and plants in sufficient amounts had not been available for planting a large area in this grass at any one time and consequently no definite yield tests had been made. About the beginning of the calendar year it was found possible to start a test along this line and 3,026 square meters were planted at Singalong during the first week in January. The system of planting in rows one meter apart and having half a meter between plants in the row was adopted. This method allows plenty of space between the rows for

irrigation, horse cultivation, and the application of fertilizers. Four good cuttings have been removed from this field during the first six months after planting.

The following table shows the growing period in days, yield, total expense, and cost per 100 kilos of each crop:

	Growth (days).	Yield. (kilos.)	Cost.	Cost per 100 kilos.
First cutting	66	4,278	₱26.50	₱0.62
Second cutting	42	4,640	18.17	0.39
Third cutting	35	8,275	53.15	0.64
Fourth cutting	40	4,350	6.22	0.14
Total	183	21,543	104.04	

The total yield during a period of one hundred and eighty-three days was, as shown in the table, 21,543 kilos, or equivalent to 78 tons of green grass per hectare.

Another plat containing 2,533 square meters, was planted during the first week in April. This crop followed corn, and received one light irrigation but no fertilizer. The crop cut during the first week in June weighed 9,455 kilos, or, otherwise expressed, produced the remarkable yield of 41 tons per hectare during a period of sixty-one days.

Roots of this grass were sent to Baguio about January 1, 1908, and immediately transplanted.. Owing to the comparatively poor soil and cold climate it does not reach its fullest development there, but a few plants set out at Naguilian are doing extremely well, reaching a height of 2 meters and showing every evidence that the grass will grow under conditions existing at that station.

At the Lamao forest reserve this grass has proved as valuable as it has in Manila.

A few Guinea grass roots were sent to Alabang in December, 1907, and transplanted on the low, heavy rice land, but it did not succeed under these conditions owing probably to the extreme stiffness of the soil. Later it was transplanted on the hillside where it gave better results. A sufficient area has not been secured as yet to make tests of the actual yield.

The area devoted to this crop at Singalong has furnished material for liberal feedings of stock, both here and at the serum laboratory, and good results have always followed its use. It is extremely palatable, horses, cattle, goats, hogs, Guinea pigs, and rabbits eating it with relish, and chickens from the near-by barrios have shown a fondness for it by persistently eating off the young, tender blades.

A practical test of the feed value of Guinea grass was made in cooperation with the office of land transportation, quartermaster's depart-

ment, which extended over a period of two months. Four lots were fed as follows:

(1) Three horses were fed each 7.5 kilos of Guinea grass, 3.1 kilos of hay, and 2 kilos of oats;

(2) Three horses were fed each 15 kilos of Guinea grass and 4.1 kilos of oats;

(3) Three horses were fed each 5.1 kilos of Guinea grass, 4.2 kilos of hay, and 4.1 kilos of oats;

(4) One horse was fed Guinea grass only.

The results of this experiment as reported by that Department are as follows:

(1) The horses showed sluggishness and falling off in weight;

(2) The horses showed sluggishness and seemed to lose weight for the first ten days, after which they gained in flesh and had a better look and appearance, finally getting back to their normal weight;

(3) The horses seemed to do well, showing no signs of weakness or falling off in flesh. They worked full time at heavy draft work;

(4) For the first twenty days the horse showed weakness and falling off in flesh, bowels in laxative condition, improving later to some extent, not seeming strong, yet doing the work.

It is evident that the third lot of horses gave the most satisfactory results and made good use of the grass furnished. It must be remembered that in feeding work horses doing heavy work it is necessary that they have a large percentage of dry feed. A horse is not so constituted that he can use large quantities of watery feed and still do heavy work, as can the carabao or bull.

Several feed tests have been made in a small way at Singalong, and have proved satisfactory in every way. A small quantity of hay was made from this grass and fed to the ponies used at the station with good results, the ponies eating it with as much relish as they did the best timothy hay.

Our work with Guinea grass during the past year has developed the following facts concerning its growth and habits under local conditions: It requires rather a high temperature, plenty of sunshine, and a soil that while moist is not too wet. An excessively wet or saturated soil is undesirable and standing water will soon kill the plants.

Guinea grass has seeded freely during all seasons of the year. The seeds ripen very irregularly and the first to ripen fall before the others have matured. Many of the seeds will germinate if the grass is cut and cured at the time the first seeds begin to fall. Care should be taken to prevent waste of seeds, which loosen and drop from the panicle as soon as a dry or cured condition of the grass is reached. It is advised that the field be gone over every few days and the heads cut and saved as they ripen.

This grass has been distributed to all of our experiment stations and in a very short time the Bureau will be able to furnish those who desire a start of this grass with either seeds or roots from these points.

Nearly 70,000 roots of this grass have been distributed during the past year to farmers and others interested in the growing of this grass. In fact, the demand has been much greater than we have been able to supply. Some request as much as 20,000 to 30,000 roots at a time, but the Bureau with its present supply can furnish only small quantities to individual farmers, which will enable them to get a start of this grass by root division, as it stools rapidly. The area can also be increased rapidly, in a comparatively short time, if it is allowed to go to seed and the seed heads gathered as they ripen, and immediately planted, by thoroughly preparing the seed bed, destroying the weeds, etc., then sowing the seed and raking it in lightly just previous to a rain, or irrigation, if this can be had.

PASPALUM DILATATUM.

This large water grass grows in low spreading bunches, produces dense masses of succulent root leaves, and is admirably adapted for pasture purposes. A planting at Singalong made from root divisions during the first week in January endured the entire dry season without irrigation. *Paspalum dilatatum* springs up quickly after harvesting, but since its province is not that of a soiling crop, no regular cuttings have been made.

TEOSINTE.

A plat 150 square meters in extent was grown at Singalong during the wet season as a test of seed production. This was planted on May 28, 1907, and when cut on November 6 yielded at the rate of 1,166 kilos of good, well-matured seed per hectare. In addition to this amount, 35 per cent (by bulk) of the product failed to mature and was thrown away as worthless. On November 16 another planting of 265 square meters was made. The seed of this crop matured almost perfectly, the yield amounting to 1,590 kilos per hectare. Another experiment was conducted with teosinte within the year to determine its value for green-forage production. This work was begun on January 7 on an area of 852 square meters. The results of this trial are recorded in the following table:

Crop.	Time (days).	Kilos per hectare.
First	69	9,810
Second	43	25,513
Third	29	26,990
Total	141	62,313

An application of stable manure at the rate of 25 loads per hectare was plowed under at planting but no fertilizer was used on succeeding crops. On good fertile soil and with plenty of water for irrigation, teosinte will produce a remarkably heavy yield of a very succulent green feed. As compared to Guinea grass teosinte has produced slightly heavier yields for the first three crops, but at the expiration of that time the stubble has become hard and woody and growth has started reluctantly or failed entirely. On the other hand Guinea grass has produced large root bunches at this time and will continue to produce heavy yields for many months.

The grass is better liked by stock and is more nutritious than teosinte. The latter has the advantage of being propagated quickly from seed, a feature that not only reduces the expense of planting but also renders possible the immediate cultivation of large areas in remote places where grass roots are not available.

RICE.

A comparative test of five varieties of mountain rice was conducted at Singalong during the early part of the year. Seed for making the planting, consisting of ypotylon, malinga, macan, sinampablo, and pinursigui, was obtained through the courtesy of Governor Knight, of Nueva Vizcaya. Palay was sown in the seed bed on June 20, 1907, and on July 20 the plants were set permanently in the field. Irrigation was given only at times of seeding and transplanting.

The following table shows the date of harvest, period in days from seeding to harvest, and yield per hectare:

Variety.	Date of harvest.	Days.	Kilos per hectare.
Ypotylon	December 12	175	1,682
Malinga	December 12	175	2,432
Macan	December 17	180	1,752
Sinampablo	October 28	131	2,000
Pinursigui	October 25	128	2,740

Pinursigui has made the most favorable showing of all varieties represented in the test. Immediately after this variety was harvested a heavy rain fell causing a second growth of palay to start. This crop matured and was cut on December 17, adding 25 kilos to the original yield, making the total yield 2,765 kilos per hectare. Ypotylon and malinga were both badly damaged by chickens feeding upon the grain before harvest. Malinga promised well and it is thought might have surpassed pinursigui in yield had it not been for the persistent attacks of these fowls. Granting this, however, pinursigui may still claim the advantages of a short season.

BEETS.

Very gratifying results have attended our work with this vegetable at Singalong. Seeds drilled on November 15, 1907, produced nice large beets in seventy-five days. Many of them weighed as much as 0.5 kilo each, the largest weighed nearly 1 kilo. Bassano's extra early turnip easily surpassed all others in size, uniformity, and productivity. For table use it is perhaps as sweet and tender as any beet grown, but unfortunately it is light red, ringed, or white in color. Lentz and Eclipse made the best showing among the red beets tested. Crimson Globe and Crosby's imported Egyptian did fairly well, but were not equal to Lentz and Eclipse. Egyptian extra early turnip and Detroit dark red turnip are small and under conditions of the test did not prove to be desirable varieties. Half long blood and long blood red are late maturing varieties of good eating quality and color. Both have long, branching, irregular roots and can not be classed as fancy beets. Bassano's extra early turnip produced 24 kilos of beets on a row 15.5 meters long, not a large, but a good yield in most sections of the United States.

CABBAGE.

A test of varieties of cabbage was made at Singalong, but owing to the fact that seed was not sown until November 14, 1907, this experiment extended into the hot, dry season and consequently indifferent results followed. Remarkably rapid growth was made during January and the first half of February, but at the time the heads began to form, the heated condition of the soil caused the plants to wilt during mid-day hours and arrested the development of the heads. Frequent irrigations were given at this time with a view to protecting the plants by reducing the intense heat of the soil. The refreshing effect of these irrigations upon the plants was very noticeable. A test in which 40 plants of each variety were set out on January 10, 1908, gave the results recorded in the following table:

Variety.	Number grown.	Number headed.	Total weight (kilos).	Weight of largest (kilos).
Winningstadt	36	24	10	0.8
Bloomsdale large late flat Dutch	32	25	12	1.0
Landreth's very early	33	27	19	1.4
Bloomsdale early dwarf	32	26	12.8	0.9
Reedland's early drumhead	38	26	28.6	2.3
Danish ball head or Holland	21	18	10	0.9
Landreth's 100-day	36	27	15.9	1.0
Jersey Wakefield	32	27	12.8	1.2
Landreth's earliest Savoy	18	13	13.2	1.3
Total	278	213	134.3	

This very poor showing can not be taken as illustrative of what may be expected from cabbage culture in Manila. Had this work been begun six weeks earlier the advantages of cooler weather for field growing should have given more favorable results.

Cabbage has also been tested at Lamao but the plants were destroyed by worms, ants, and other insects so that no data were secured on the crop grown there.

SWEET POTATOES.

Twenty-six tubers of a variety of sweet potatoes were introduced from the southern part of the United States and sent to Singalong on November 6 for planting. Plants propagated from these tubers and planted in the field on November 27 developed a very vigorous vine growth. The tubers, however, were attacked by a small, white, maggot-like larva in such numbers as to destroy the entire crop. This insect, *Cylas turcipennis* Bohem. (*Curculiondæ*), was identified by the Bureau of Science entomologist. It feeds first upon the surface and then bores deeper into the tuber, causing the total destruction of the latter before maturity is reached. Three different plantings on as many different plats have been under observation at the station during the year and all have been ruined by this borer.

TOMATOES.

A few plants of the Ponderosa variety were grown from seed introduced from California by Dr. Stevens, of Manila. These produced a remarkably vigorous vegetative growth but remained almost barren of fruit. The few tomatoes that did develop were of superior quality, but the number was small and it would not be a serious error to report the crop a total failure.

An attempt has also been made to grow tomatoes at the Lamao experiment station. The American varieties tested there have made excellent growth of vine, but refused to set fruit, as was mentioned regarding the tomatoes grown at Singalong. After the vines had reached considerable height they were attacked by a fungous disease and destroyed.

LETTUCE.

This has been one of the most successful crops grown at Singalong within the year. Seeds of six different varieties were sown in the seed bed on February 12, 1908; these varieties were prizehead, big Boston, early curled Simpson, Hanson, passion, and salamander. The seedlings were pricked out and potted to 2-inch pots during the last week in February and a week later were planted permanently in the field. Prizehead surpassed all other varieties in the test. Planted 30 centimeters apart in either direction the plants developed until they interlapped and completely

hid the ground upon which they were grown. The reddish curled leaves were extremely crisp and tender.

The following varieties were also planted at La Granja: Big Boston, prizehead, Hanson, early curled Simpson, and passion. After the plants had attained sufficient size they were transplanted into beds, as was done at Singalong. At this place prizehead and big Boston seemed to do better than the other varieties, yet they did not do as well as prizehead at Singalong.

At Lamao, Bataan Province, the same varieties were tested as at La Granja, and in a similar manner, except that tests were made by planting under half shade and in the open field. About the same space was given as mentioned for the other stations, with the results that under shade conditions early curled Simpson made a very favorable showing, maturing early and producing large, crisp heads from 33 to 36 centimeters in diameter, more or less compact. Passion ranks next in size of head and compactness, although it matures several days later. Under open field conditions big Boston gave the best results. It seems to withstand the hot sun and matures comparatively early, producing large heads. This is a semicurled variety and the heads are not as compact as in noncurling varieties. The other varieties gave fairly good results under field conditions.

In this climate lettuce should be planted so as to mature during the cool season, as warm weather tends to make the plants go to seed before the head has fully developed.

FRUITS.

AVOCADO.

There are several fairly thrifty trees of the alligator pear growing on the Singalong station grounds. These have grown and appeared vigorous and healthy throughout the year. The tree that bloomed last year flowered profusely again during the past season, but again it failed to set fruit.

Scale insects have been present on these trees in large numbers during the dry season.

The avocados growing at Lamao are making rapid growth of wood, but as yet none have flowered.

In view of the fact that only about 20 per cent of seedling trees bear fruit in any quantity, it will probably be necessary to import some budded or grafted trees of known bearing varieties.

GRAPES.

Two of nine vines of the Malaga variety growing at Singalong have matured fruit during the past season. This was the first fruit borne by these vines and only a few small bunches were produced. Another

variety of the zinfandel type is under cultivation here, but as yet it has failed to fruit.

During the past year several plants of the scuppernong grape, a variety grown extensively in the Southern States, were imported for test under climatic conditions here. This variety grows extremely well near the seacoast from Jamestown to Florida.

ORANGES.

The California orange trees planted at Singalong six years ago are fruiting fairly well during the present season. Six trees are fruiting and one of this number carries 92 oranges that are now nearing maturity. The fruit is smooth, well formed, and of good size.

The orange trees imported from California and Australia, growing at Baguio, are making fairly good growth and one naval orange tree is now bearing fruit.

KUMQUATS.

Five trees of this small citrus fruit have been grown under rather adverse conditions, but have fruited remarkably heavily and have continued to bear throughout the entire season.

BANANAS.

A small plantation including the varieties gloria, sabá, matabia, latundan, bongolan, lacatan and lacatan bula, was set out at Singalong on August 3, 1907. All varieties have made very satisfactory growth. Fruit of bongolan, latundan and the lacatan varieties has reached maturity. Matabia will, judging from present indications, ripen fruit by July 10, 1908. The cutting stage of gloria is still two months distant, while sabá, with its monster plant, 6 meters high and more than one-third meter in diameter near the ground, shows no evidence of fruiting. The Chinese dwarf banana has also been grown and it has produced large bunches of fruit which was at least well above the average in quality. Plants of this banana sustained much less damage from winds than did those of other varieties.

At Lamao experiment station experiments have been started to test the value of different fertilizers for use on bananas, as well as methods of cultivation, mulching and irrigation. Results will not be available from these experiments for two years at least.

MISCELLANEOUS.

LEMON GRASS.

The small area of this grass now in cultivation at Singalong is doing nicely. The original planting was made from two large root clumps brought here from Lamao by the Director of Agriculture, and subdivided for planting on November 6, making 110 plants. Three months

later these were almost as large individually as either of the original bunches. On February 6, twenty-one root divisions were received from Baguio and immediately planted in the field. These were prepared for shipment under direction of the Secretary of the Interior with a view to determining the vitality of the roots and their ability to grow and produce plants after shipping under unfavorable conditions. Before shipping, all roots were removed from thirteen of the plants, while eight divisions were allowed to retain their roots. Just one small, slender plant from which all roots had been cut failed to grow, indicating that these roots are signally tenacious of life. Very interesting variations in the habits of growth of the Bataan and Benguet grasses were observed soon after planting. Growth was at first much more rapid in the plants coming from Benguet than was the case in the plants from Bataan. The leaf sheath of the former was almost white, while that of the latter was a distinct purplish red. It was thought that two distinct varieties had been found, but later developments proved them identical. So far, neither yield tests to show the production from a given area nor analytical tests to determine its content of oil have been made.

A considerable amount of this grass is now growing at Lamao and is available for distribution.

VETIVER.

This stout-growing medicinal and perfume-yielding grass has made rapid growth at Singalong. From 330 roots sent to the station by the Secretary of the Interior during the second week in February, only 3, or less than 1 per cent, were lost in the process of planting. By the end of June this grass had developed a very strong system of tough, fibrous roots. The erect, growing, reed-like blades stood in dense masses 1.5 to 2 meters in height and flowering had just begun on June 30.

ROSELLE.

One row about 60 meters in length was drilled to this splendid jelly plant (*Hibiscus sabdarifa*) on January 31, 1908, and later the plants were thinned to about 1 meter apart. After five months of growth the plants are from 1.5 to 2 meters in height, are bushy and vigorous, but do not show indications of flowering.

SEED AND PLANT DISTRIBUTION.

It is the object of the Bureau in distributing seeds to furnish planters with sufficient seed, of such promising species and varieties as are not readily obtained elsewhere in the Islands, to give them a fair trial and if satisfactory provide a source from which they may collect their own seed for future crops. That interest in the extension of the number of crops that may be profitably cultivated here either for home consumption or for market has not in the least abated is clearly shown in the

following table giving the total distribution made during the fiscal year ending June 30, 1908:

Crop.	Year ending June—	
	1907.	1908.
Vegetables	3,763	8,600
Flowers	173	533
Maguey	220,000	1,465,115
Guinea grass		60,900
Mulberry		1,742
Other farm crops	2,184	6,531
Miscellaneous		487

FIELD CROPS.

The principal distribution of seeds of field crops has been confined to corn, cotton, Guinea grass, kapok, peanuts, rice, sesamum, maguey, and tobacco, but there is a constant and increasing demand for various other plants of economic importance such as a hardy variety of coffee, cacao, spices, rubber, and various fruits. The Guinea grass has attracted more attention than any other single crop excepting maguey, and during the past nine months 60,900 plants, enough to plant 24 hectares, have been propagated and sent out from Singalong.

MAGUEY.

During the past year some 42,475 plants and bulbils of Hawaiian maguey and 1,422,640 of Ilocano maguey have been distributed to thirty-two provinces. In many cases these have been delivered in large consignments to the governors of the provinces or other persons so situated as to be able to make the smaller distributions to individuals to the best advantage.

Taking into consideration the number of plants distributed last year and the number planted out at several of the stations of the Bureau for propagation, it would seem that very shortly others who wish to plant will be able to secure plants locally or from the stations of the Bureau, thus relieving the necessity of making further extensive purchases abroad, so that funds used heretofore for this purpose may be devoted to introducing and improving other valuable crops.

VEGETABLES.

As a result of previous years' experience, the number of varieties of vegetables distributed has been somewhat limited, and only such seeds are sent out as have given a fair success with ordinarily good cultivation. These consist of beans, beets, cabbage, carrot, corn (field), cucumber, eggplant, lettuce, mustard, okra, peas, pepper, radish, tomato, and turnip.

A number of reports indicate, as usual, that insects cause considerable trouble to young seedlings. In the case of cucumbers this can be largely overcome by placing a piece of mosquito net over the young plants, and

after they get too large for this, spray the leaves with some arsenous mixture, such as Paris green, or dusting the leaves thoroughly and frequently with air-slaked lime or wood ashes. In the case of many plants such as lettuce, cabbage, tomato, etc., that stand transplanting, the carrying away of seed by ants may be avoided by sowing the seeds in flats and transplanting to the field as soon as large enough to handle. A number of reports have indicated a lack of knowledge as to the use of the different vegetables after they are grown, and so it has been deemed advisable to combine with the instructions for planting, in the pamphlet sent out with the various collections of seed, simple instructions for the preparation and use of the vegetables.

FLOWERS.

While the distribution of flowers and seed of ornamental plants may not bring in direct financial returns it is considered that the general effect on the communities, where some attention is given to this side of gardening, is sufficiently beneficial to justify some attempt at keeping up with the demand for this class of seeds. During the past year three times the number of collections sent out the previous year were distributed, and a number of requests were not filled for lack of seed.

REQUESTS.

Many requests have been received, which, while they indicate a desire to obtain and plant better fruits and other crops, show a decided lack of information as to what fruits are desirable for this country. This particularly refers to continued applications for apples, plums, and such fruits of northern and temperate countries marked by decided winters during which the plants receive a complete rest which can not be obtained here, even though a decided dry season may tend to have somewhat the effect of a winter in causing the plants to become dormant. While varieties of these fruits more or less hardy to local conditions may be ultimately secured by breeding and selection, it is not advisable to make any general distributions at present, as it is almost sure to lead to discouragement through the repeated failures that must be expected.

Another feature of requests that is markedly noticeable at times is the large number received from school children who desire seed for planting in school gardens. This is an excellent move and one worthy of encouragement, but it is believed that much more satisfaction could be obtained and much needless expense spared if the teachers would make the request direct, stating the amount required for the ground they are expecting to cultivate, rather than requiring each student to obtain seed for his own small plot.

PLATE II. SUPERINTENDENT'S HOUSE AT SINGALONG.

EXPERIMENT STATIONS.

Heretofore much of the work at the various experiment stations has been of the nature of commercial crop growing and demonstration work, in which attempts have been made to show the farmer that certain crops could be grown and how to grow them. This work has its value, but properly belongs to agricultural extension work on account of its educational nature. It is the intention of the Bureau to continue this work in so far as it seems to be necessary in the absence of any other agency for carrying on the work, but more attention will be given to collecting, testing, and breeding native varieties of our various farm crops, as well as foreign crops, thought to be suitable to these Islands.

One line of work which the Bureau is planning to undertake this coming season, is the collecting and testing of the native varieties of rice. Many hundreds of the so-called varieties are grown in these Islands, some of which are superior to any foreign variety introduced. An attempt will be made to collect these and test them under various conditions and ascertain the best conditions suitable to their growth as well as to the value of fertilizer for the cheapest production.

Many varieties of corn are grown in various sections of these Islands, from which may be selected and improved a variety which should prove better than any of those introduced.

Work of this nature will be pushed as rapidly as funds at our disposal will permit.

Constant changes of the superintendents at these stations has interfered greatly with the work. The principal reason for these changes is the short term of service of these men and the fact that the Bureau is unable to raise their salaries in order to hold them.

In experiment station work it takes some time to get the work in hand and be able to reach any valuable results, owing to the fact that experiments must be run two or three years in order to duplicate the work and eliminate the effect of seasons. These frequent changes have also made it difficult to secure complete notes on many of the experiments under way. It is also difficult to find men adapted to this kind of work, just as in any other business.

As the work grows older and becomes better organized, it is hoped that these difficulties will disappear.

SINGALONG EXPERIMENT STATION.

The work at the Singalong experiment station was in charge of Mr. Harold B. Ross up to October 7, 1907, at which time he resigned, and Mr. J. B. Thompson has since had charge of the work.

LOCATION.

The Singalong experiment station is located in the southern part of Manila, about one-half kilometer distant from Manila Bay. The point at which Calle Wright terminates in Calle San Andres lies almost in the center of the grounds. The station comprises a little more than 4 hectares of land, including lawns, drives, and grounds occupied by buildings, corrals, etc. The soil is light and sandy. An estero, into which salt water from the bay enters at high tide, lies facing the grounds. The fact that many of our deep-rooting plants and trees have not produced good results is perhaps due in part to the presence of this salt water. The highest elevation of the station grounds does not exceed 2 meters.

WATER SUPPLY.

A 6-inch artesian well is the source of water used at Singalong. The water in this well rises to within 1 meter of the surface and is pumped into a 6,000-gallon tank, having an elevation of 8 meters, by means of a 6-inch duplex pump. On April 28, 1908, the only time during the past year, it was found necessary to suspend pumping operations for a few hours due to a failure in the water supply. The 8-horsepower steam engine previously used for pumping has been removed to the bodega for grinding corn, and a 20-horsepower electric motor installed in its place. This change facilitates irrigation by eliminating the waste of time consumed in generating a sufficient head of steam to operate the plant.

The pipe system through which water is carried to all parts of the grounds consists of a 3-inch pipe at the pressure tank, gradually decreasing to 1 inch at remote points of the system. Practically all irrigation is done through 1-inch hydrants or "turn-outs." The hourly cost of running this plant, without considering interest on the original investment, wear of machinery, or risk from accidents, is about ₱0.60.

EQUIPMENT.

Two good Kentucky mares are used at the station to perform all general farm and team work. Common farm implements, such as an escort wagon, stirring plow, steel harrow, five-tooth cultivator, wheel hoes, garden seed drills, and other hand implements have been provided.

LABOR.

Radical changes have been made during the year in that line of the work with which the employment of labor is concerned. Superintendent Ross carried into effect on August 1, 1907, a revised pay roll providing for a general reduction both in wages and in the amount of labor employed. This measure reduced our force from twenty-eight to eighteen laborers and decreased the average daily wage from ₱1.14 to ₱0.90. Despite these changes no difficulty has been experienced in securing

help when needed. The labor force here is composed largely of experienced men, who have been employed at the station for a period of two or more years. With a few exceptions they have rendered satisfactory and efficient service.

CLIMATE.

Weather conditions have been in some respects unusual. The wet season of 1907 was late in opening but continued correspondingly late in the fall. Due to this fact no general irrigation was demanded prior to the second week in February, and good rains on the 15th and 25th rendered further irrigation during that month unnecessary. Rain fell again on March 29, putting the soil in excellent condition. The wet season opened again on May 3, and since that time no irrigation has been needed. A typhoon struck Manila on October 26 and caused considerable damage to crops and plants growing at the station. Another, more severe and of longer duration, visited us on May 28 and 29, doing much damage to vegetation.

All things considered, weather conditions have been possibly more than usually favorable for a majority of the farm operations being performed.

DISPOSITION OF GREEN FORAGE AND SEEDS.

Forage-growing experiments conducted here and recorded elsewhere in this report have furnished an abundance of green feed for all live stock maintained at the station, besides a considerable surplus which has been delivered at San Lazaro for feeding to the serum herd. Guinea grass was also furnished the quartermaster's department for conducting a feeding experiment in which this grass was fed to horses. The following table shows the different feeds removed from Singalong since October 7, 1907:

	Quartermaster's department (kilos).	Serum laboratory (kilos).
Guinea grass	10,909	36,608
Teosinte		3,140
Green corn		1,950
Total	10,909	41,698

Making grand total of 52,607 kilos.

Seeds grown at this station have been sent to the office and turned over to the division of seed and plant industry for distribution. They have been furnished in comparatively small quantities. Among others were 1,985 kilos of palay, about 145 kilos of velvet beans, and 55 kilos of teosinte.

There is no fence surrounding these grounds hence it is impossible to grow many crops successfully owing to the depredations of animals such as dogs, hogs, and chickens, as well as people, trespassing on the land and destroying the value of experiments by carrying off the fruits and vegetables. Although a watchman is kept on the ground at night it is impossible to stop this vandalism.

SILK CULTURE.

Near the close of the last fiscal year this Bureau, in connection with the Bureau of Science, started a series of coöperative experiments in silk culture at Singalong.

This work has been under the direct supervision of Mr. W. Schultze, of the Bureau of Science, with Mr. José Dizon, of this Bureau, in charge of the feeding and care of the silkworms. Two men have been used for collecting leaves, which have been obtained both from the station grounds and in other parts of the city. Two girls are now employed in the silk house.

Owing to the fact that the supply of mulberry leaves has been limited, it has not been possible to carry on the experiment with more than about 11,000 worms for each generation. The supply of leaves consumed daily by the 11,000 worms varies according to their age, as follows:

	Kilos per day.
First age (from the first to the third day)	0.9
Second age (from the fourth to the fifth day)	1.4
Third age (from the sixth to the seventh day)	2.3
Fourth age (from the eighth to the tenth day)	11.4

During the four periods they consumed a total of 44.5 kilos of leaves, or an average of 11.1 kilos for each period.

As soon as the larvæ show a yellowish transparent color, they are placed in wire baskets filled either with rice straw, dry weeds, cogon, or broom corn; or in wooden baskets divided into sections by small bamboo sticks. Of the different materials used, broom corn has been found to give the best results as it causes less waste of silk than the other materials.

Three days after each generation is pupated the cocoons are sent to the Bureau of Science where they are prepared for spinning the silk. Before they are sent, 300 of the best cocoons are selected for breeding purposes. These latter are placed on three trays covered with paper, and in about ten days the moths emerge from the cocoons.

Breeding is allowed to take place at once, after which the females are placed on a piece of circular filter paper. One day after, the females lay their eggs.

With the exception of the first and second generations, at which

time the work was in the hands of the Bureau of Science, the number of cocoons obtained from June 1, 1907, to June 30, 1908, is as follows:

	Cocoons.
Third generation	1,670
Fourth generation	5,570
Fifth generation	11,320
Sixth generation	8,290
Seventh generation	11,343
Eighth generation	9,533
Ninth generation	11,768
Tenth generation	4,659
Eleventh generation	8,671
Total	72,824

During the month of June, 1908, a reeling machine and a roll upon which to wind the silk have been constructed, and the girls working in the silk house are now being taught to reel silk.

SALE OF SINGALONG STATION.

The Assembly passed an Act providing for the sale of Singalong experiment station and the work now carried on there will be moved to Alabang. The soil at Alabang is somewhat different from that at Singalong, containing more clay and being poorer in plant food owing to the fact that it has been in cultivation a number of years.

BAGUIO EXPERIMENT STATION.

The work at the Baguio experiment station was in charge of Mr. G. J. Petrelli from the beginning of the fiscal year to May 30, 1908, at which time he resigned and Mr. M. C. Merrill was placed in charge as acting superintendent.

LOCATION.

This station is located about 5 kilometers north of the town of Baguio in the Trinidad Valley, which is a crater-like depression drained by the Balili River, which passes through this valley. It bounds the farm on the east side, and makes its exit through a notch on the north side of the valley. The altitude of this section is approximately 1,500 meters.

SOIL.

The soil at this station is a sort of silt, alluvial loam and is very deep, having been formed by the erosion of the near-by limestone rocks and clay hills, and deposited by the Balili River, which is now cutting a meandering course through its former deposit. The soil is lacking in humus and is poor in plant food so that the use of commercial fertilizers and all the manure that is available is necessary for the production of crops.

CLIMATE.

As mentioned in our last report the temperature in this section reaches the frost line in midwinter and the rainy season is a little earlier than on the west coast of the Islands, that is, beginning in May and ending in October. On account of these facts this section of the Philippine Islands has given promise of growing successfully many fruits and vegetables adapted to semitropical conditions elsewhere, but not adapted to sea-level conditions here.

The fact that the summer capital has been established at Baguio and that there is considerable demand for fruits and vegetables during the dry season, especially during March, April, and May, has made it almost imperative that this station grow vegetables on a commercial basis to supply the demand at that time. This has interfered materially with strictly investigational work, and as soon as private parties can be induced to take up this line of work and supply the demand, vegetable growing on a commercial basis will be discontinued and the work confined more to investigational lines.

A heavy typhoon and rain on May 28 did considerable damage to young trees and vegetables.

WATER SUPPLY.

Irrigation is necessary during the greater part of the dry season. The water for this purpose is obtained from the Balili River at a point about one mile from the station, and is conducted to the farm in a small canal. The drainage of surplus water, as far as slope is concerned, is poor, the farm being so nearly level. The somewhat porous nature of the soil, however, renders underdrainage unnecessary.

LABOR.

Both men and women native laborers have been employed in the past. For the lighter grades of labor, the Igorot girls and women are probably just as efficient and satisfactory as the men, as they are inured to labor from childhood, and are therefore very muscular. The daily wage for each laborer averages about 50 centavos. The average number of laborers per day, during the past year, has been twenty-six.

OPERATIONS.

During the past year considerable work has been done in beautifying the ground and erecting buildings. A commodious house has been erected for the superintendent and officers in charge; roads have been laid out and graveled; and many ornamental plants have been set out.

Work has been confined largely to the testing of such vegetables and fruits as are suitable to existing climatic conditions. Many thousand strawberry plants have been grown for distribution to parties who wish them. Some forage crops have been tested, but owing to the cool climate and rather poor soil conditions, satisfactory results have not been ob-

tained. Experiments in crossbreeding and seed selection of varieties of tobacco have been carried on at the substations Sablan and Naguilian during the year. Seeds were saved from many of the most promising plants and distributed to other sections of the Islands.

Owing to change of management of the station during the year, complete data on many of these experiments can not be obtained.

The apple, quince and loquot trees growing at this station are doing fairly well, but as yet no fruit has been secured. One peach tree has borne fruit, but the fruit was of poor quality, lacking flavor. One small fig tree is now bearing fruit, and an attempt will be made to propagate more extensively. A native variety of raspberry has been propagated which produces a large, highly colored fruit, but lacking in flavor. Imported varieties have not done so well as native varieties.

LAMAO EXPERIMENT STATION.

The work at the Lamao station was in charge of Mr. H. C. Cuzner up to October 1, 1907, at which time he was promoted to agricultural explorer and Mr. R. L. Clute placed in charge. Mr. Clute transferred to the veterinary division on January 1, 1908, and was succeeded by Mr. H. E. Stevens.

LOCATION.

The Lamao experiment station is located on the Lamao forest reserve, near Manila Bay, on the Lamao River, in Bataan Province. Most of the land now in cultivation is broken and hilly.

SOIL.

The soil is underlaid with drift bowlders, cobble stones, and large gravel, and varies from red clay to beach sand, including all varieties of sandy loam. It has evidently been formed by washings from the mountain sides. In many places it is so porous that it is difficult to conduct an irrigating ditch across it without puddling the ditch or fluming. Most of the land was originally covered with forest which makes it rather difficult to bring the land into cultivation. The fertility, however, is somewhat above that of the other farms, owing to the fact that it has never been cropped and the fertility removed.

CLIMATE.

The climate at this station is very similar to that in Manila, except that showers are more frequent, on account of its being near Mariveles Mountain.

WATER SUPPLY.

This station is well supplied with water by an irrigation ditch taken from the Lamao River. This river supplies an abundance of water at all times, and all that is necessary to secure it is to build a dam of bowlders across the stream in the dry season in order to run the water into the irrigation ditch.

LABOR.

Some difficulty has been experienced in securing good labor during the past year, owing to the presence of a sawmill in the vicinity of the station which pays higher wages than was paid at the station. It was found necessary to increase the wages from ₱0.60 a day to ₱0.75 in order to secure the necessary labor.

BUILDINGS AND EQUIPMENT.

Little has been done in the way of building at this station owing to the fact that no live stock is kept there except the work animals, and only a few buildings are necessary. The superintendent's house has been finished, and now suitable quarters can be had for scientific workers and investigators who wish to stop there for a limited time.

The equipment of the station consists mainly of hand tools and a few plows that are used in cultivating the crops.

OPERATIONS.

The work at this station has been confined largely to the testing of vegetables, growing of nursery plants of kapok, abacá, maguey, bananas, and pineapples. Many other tropical fruits have been sent there for trial but as yet no report can be made upon them.

INSECT PESTS AND PLANT DISEASES.

Plant diseases have done considerable damage to vegetables during the past year.

In May a swarm of locusts appeared and did considerable damage to corn and other crops growing on the place.

LA CARLOTA SUGAR FARM.

The work at the La Carlota sugar farm has been in charge of Mr. H. J. Gallagher since April, 1905.

LOCATION.

This farm is located at the foot of the volcano Canlaon, about 6 kilometers east of the town of La Carlota, Occidental Negros. It was established by the Spanish Government as a sugar experiment station, but so far sufficient means have not been at hand to carry on the operations satisfactorily.

SOIL.

The soil at this station is well adapted to the production of sugar, being of a black, volcanic nature, resembling in many respects that of the Middle Western States. The soil is very deep, filled with bowlders, cobble stones, and large gravel. The subsoil is open and porous, rendering under drainage unnecessary.

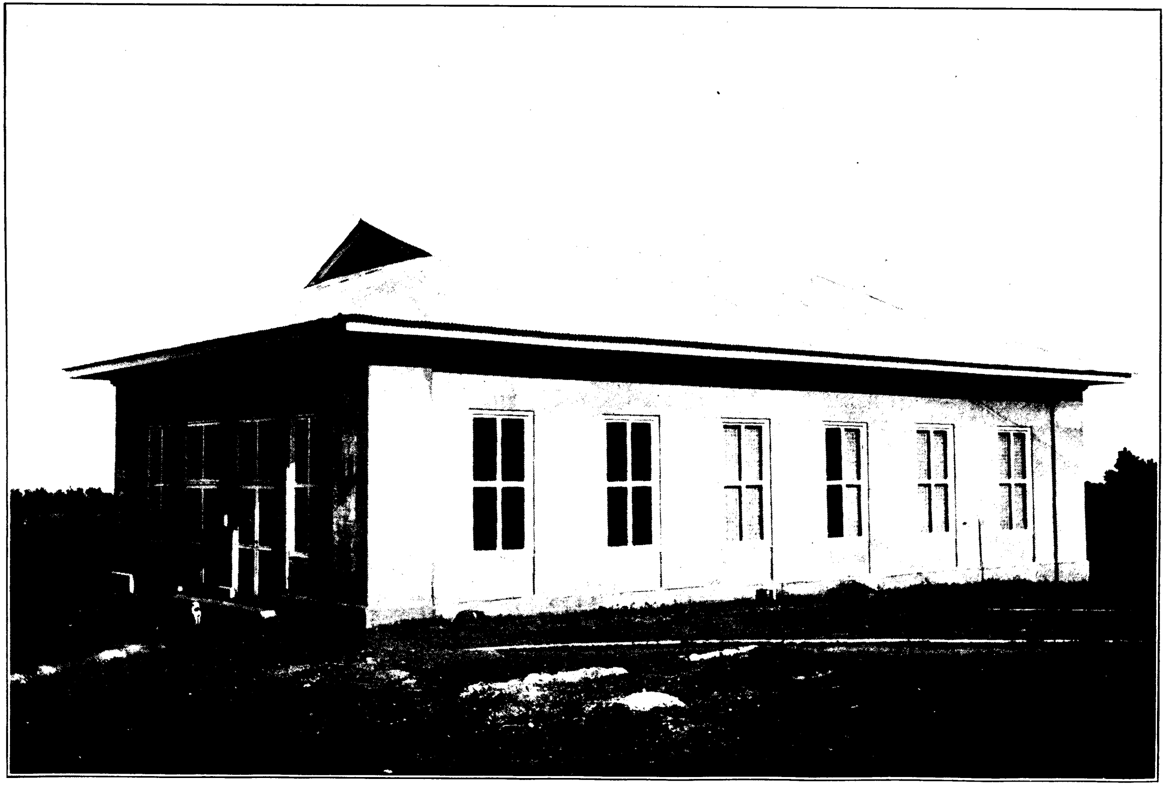


PLATE III. SERUM LABORATORY, ALABANG.

WATER SUPPLY.

A river of considerable size bounds the farm on one side and there are several smaller streams within its limits. A dam has been constructed in the larger river and a canal built which carries the water a considerable distance from the stream where it enters a tunnel through which it passes down to the sugar mill, where it is used to produce the power required for milling the cane produced on the farm. A branch of this canal carries the water out farther on to the farm, where it becomes available for irrigation purposes. Much trouble has been experienced in attempting to use the water of this river for irrigation purposes, as the hacenderos having mills farther down the river complain that there is a lack of water for power when it is used for irrigation purposes higher up the stream.

EQUIPMENT.

Little change has been made in the equipment of this farm during the past year, the old, antiquated sugar machinery still remaining in use.

OPERATIONS.

Little has been grown at this station except sugar. A few crops have been grown in an experimental way, such as vegetables, etc., but as this is in the sugar district the main crop is sugar. This crop consisted last year of 36 hectares of rattoon cane, 13 hectares being first year rattoon and 23 hectares being second and third year rattoon. The first year rattoon produced 3,862 kilos per hectare, the second and third year rattoons produced 2,295 kilos per hectare. The total yield of sugar was 102,991 kilos. The crop was about an average one for this province. Six varieties of cane are being tested for adaptability to climatic conditions and yield. Nursery plants of maguey, sisal, and kapok are being grown for distribution.

No live stock is kept at this station except the work stock used in farm operations. Foot-and-mouth disease broke out among the work stock in April and interfered with farm operations to some extent, but all have recovered and are now working again.

LIPA EXPERIMENT STATION.

This station is located near Lipa, Batangas Province, and was started some years ago to see what could be done toward reviving the coffee industry, but owing to the ravages of insects and diseases the trees have not made much growth.

Funds have not been available to push this work beyond the preliminary stage.

DIVISION OF ANIMAL INDUSTRY.

This division includes the veterinary control work, the serum laboratory, the dairy farm at Alabang, the Trinidad stock farm at Baguio, and all general investigations in animal industry.

CONTROL WORK.

GENERAL CONDITIONS.

The general conditions of animal diseases in the provinces have been distinctly worse during the year just ended then they were for the previous fiscal year. The loss of ground was due largely to the increase in the diseases prevailing among imported cattle, and to the unavoidable delay in enacting and enforcing a satisfactory quarantine law prohibiting the importation of diseased cattle and regulating the movements of live stock in the Philippine Islands.

The people of the provinces have continued to show their increasing faith in the ability of this Bureau to control infective animal diseases, by the greater support which they have given the veterinary work during the past fiscal year. Their coöperation is absolutely essential to ultimate success, but if the number and extent of outbreaks of diseases continue to increase this will undoubtedly afford just cause for the withdrawal of a large measure of their support, which has been gradually increasing during the past two years. This fact is of considerable significance. Even though much of the work necessary to the final control of animal diseases remains yet to be undertaken, the work so far done is having a constant beneficial effect.

The ultimate object should be the complete eradication of these diseases. Immunity to them is too expensive to be given serious consideration. Remedies to prevent, control, or cure them are only palliative. The only security of real merit is the knowledge that they do not exist in the country and are not likely to be reintroduced.

One of the worst features has been the necessity for constantly moving employees from one province or island to another, while the work on which they were engaged was incomplete. This Bureau should be able to maintain its agents permanently in each province and important island, so that they will become familiar with the territory and people and thus be able to do more effective work by being constantly on the ground to give prompt attention to outbreaks when they occur. This will also result in economy, as the travel necessary under present conditions is excessive compared with the amount of work done.

QUARANTINE LAW.

In view of the persistence of animal diseases in the territory from which most of the cattle shipped to the Philippines are received, efforts have been made for more than two years to secure the passage of a satisfactory law for the control of infective diseases among imported animals. On October 12, 1907, the Philippine Commission passed Act No. 1760, which is as follows:

[No. 1760.]

An Act to prevent the introduction into the Philippine Islands of dangerous communicable animal diseases, to prevent the spread of such diseases within the Islands, and for other purposes.

By authority of the United States, be it enacted by the Philippine Commission, that:

SECTION 1. For the purposes of this Act domestic animals are hereby defined as horses, mules, asses, cattle, carabaos, hogs, sheep, goats, dogs, deer, and circus animals or those intended to be used for show purposes.

SEC. 2. For the purposes of this Act a dangerous communicable animal disease is hereby defined as glanders or farcy, surra, rinderpest, hemorrhagic septicemia, hog cholera, foot-and-mouth disease, or any other acute communicable disease which may cause a mortality of over five per centum in the period of one month.

SEC. 3. It shall be unlawful for any person, firm or corporation knowingly to ship or otherwise bring into the Philippine Islands any animal suffering from, infected with, or dead of any dangerous communicable disease, or any effects pertaining to such animal which are liable to introduce such disease into the Philippine Islands: *Provided,* That any such animal or effects may be permitted by the Director of Agriculture to enter the Islands under such conditions as to quarantine, cremation, or other disposal as he may direct, or which shall be deemed by him sufficient to prevent the spread of any such disease.

SEC. 4. It shall be unlawful for any person, firm or corporation knowingly to ship, drive, or otherwise take or transport from one island, province, municipality, township, or settlement to another any domestic animal suffering from any dangerous communicable disease or to expose such animal, either alive or dead, on any public road, street, or highway where it may come in contact with other domestic animals.

SEC. 5. Whenever the Secretary of the Interior shall declare that a dangerous communicable animal disease prevails in any island, province, municipality, township, or settlement, and that there is danger of spreading such disease by shipping, driving, or otherwise transporting or taking out of such island, province, municipality, township, or settlement any class of domestic animals, it shall be unlawful for any person, firm or corporation to ship, drive, or otherwise remove the kind of animals so specified from such locality except when accompanied by a certificate issued by authority of the Director of Agriculture stating the number and kind of animals authorized to be shipped, driven, taken, or transported, their destination, the manner in which they are authorized to be shipped, driven, taken, or transported, and their brands and distinguishing marks. Such certificate shall also state that the animals in question have been inspected by a duly authorized agent of the Director of Agriculture and found free from dangerous communicable animal diseases and shall give the date of such inspection.

SEC. 6. The Director of Agriculture is hereby authorized—

(*a*) To maintain inoculation, quarantine, and detention stations for domestic animals in such places as may be approved from time to time by the Secretary of the Interior, and to place all animals arriving from foreign and domestic ports or interior places in quarantine for such time as he may deem necessary to prevent the introduction and spread of dangerous communicable animal diseases.

(*b*) To inspect all domestic animals arriving by boat, rail, or otherwise in the cities, ports, or places where quarantine stations are maintained and in such other places as he may deem necessary for the purpose of preventing the introduction and spread of dangerous communicable animal diseases within the Philippine Islands.

(*c*) To require that animals which are suffering from dangerous communicable diseases or have been exposed thereto be placed in quarantine at such place and for such time as may be deemed by him necessary to prevent the spread of such disease.

(*d*) To require the cleaning and disinfecting of any utensil, place, corral, yard, or building deemed by him to be infected with dangerous communicable animal disease, and to prohibit the keeping of any domestic animals in such place, corral, yard, or building until it has been placed in a sanitary condition.

(*e*) To require the cleaning and disinfecting of any boat, car, vehicle, or other conveyance deemed by him to be infected with dangerous communicable animal disease, and to prohibit its further use for transporting domestic animals until it has been placed in a sanitary condition.

(*f*) To coöperate with provincial and municipal boards in the suppression of dangerous communicable animal diseases and in the establishment and maintenance of municipal slaughterhouse and milk-inspection systems, the object of which shall be to prevent the slaughter and sale of animals having diseases or injuries of such a nature as to render the meats and other food products derived from them dangerous or unwholesome for human food.

SEC. 7. Whenever the Director of Agriculture shall order any animal placed in quarantine in accordance with the provisions of this Act, the owner of such animal, or his agent, shall deliver it at the place designated for the quarantine and shall provide it with proper food, water, and attendance. Should the owner or his agent fail to comply with this requirement the Director of Agriculture may furnish supplies and attendance needed, and the reasonable cost of such supplies and attendance shall be collectible from the owner or his agent.

SEC. 8. Any person violating any of the provisions of this Act shall, upon conviction, be punished by a fine of not more than one thousand pesos, or by imprisonment for not more than six months, or by both such fine and imprisonment, in the discretion of the court, for each offense.

SEC. 9. The public good requiring the speedy enactment of this bill, the passage of the same is hereby expedited in accordance with section two of "An Act prescribing the order of procedure by the Commission in the enactment of laws," passed September twenty-sixth, nineteen hundred.

SEC. 10. This Act shall take effect on its passage.

Enacted, October 10, 1907.

Early in this year the number of shipments infected with rinderpest greatly increased. The enforcement of the law, however, was generally opposed by the cattle dealers, who claimed that it would work a hardship on buyers desiring animals either for work purposes or for slaughter.

When it became evident that, to prevent the further importation of diseased cattle into the Philippine Islands, vigorous measures would have to be adopted for the enforcement of the quarantine law, a veterinarian of this Bureau was sent to Indo-China for the purpose of investigating the possible supply of cattle from that country. This action was taken because large shipments were already arriving from Indo-China. Those cattle are of the same type as the native and Chinese cattle, are from about the same climate as the Philippines, and are generally free from disease. There are, also, in this territory an abundance of carabaos, which can be purchased at reasonable prices.

It was learned from this investigation that the French Government in Indo-China has a thorough system of veterinary inspection, and Pasteur institutes connected with the department of agriculture. The work done in the control of animal diseases covers the entire territory. These facts indicate that Indo-China is a satisfactory source of supply of cattle for the Philippines.

This veterinarian was also instructed to investigate the conditions which prevail in Hongkong and report on the possibility of lessening the amount of disease existing among cattle shipped to the Philippines from that port. The information which he gathered seemed to show that the conditions under which cattle are handled in the Hongkong live-stock depot are not such as to give any guaranty that diseases will not appear there at almost any time. Soon after he returned, a shipment of cattle from Hongkong was found to be infected with foot-and-mouth disease, but before any effective measures could be taken to prevent the further importation of the disease, it had spread over the city of Manila from the private corrals in which the owners had stored the infected cattle.

General Order No. 9, designed to prevent the further importation of diseased cattle, was issued on April 30, 1908. This order met with violent opposition from several cattle dealers in the city of Manila and its operation was temporarily suspended.

At the request of the Governor-General, the colonial veterinarian of Hongkong was sent to Manila for a conference relative to the cattle trade between that port and the Philippines. The result of this conference was a decision that since the colonial government of Hongkong has no jurisdiction over the Chinese territory from which cattle are received for export, it has no means of controlling diseases among such cattle. Because of this fact there is constant infection of the stockyards at that port and of many shipments leaving there for these Islands.

On June 5, 1908, the order excluding infected cattle was reissued in the form of General Order No. 10, and on account of the diseases prevailing in Hongkong all shipments from that port have temporarily ceased.

Importers have been bringing in a few dairy cattle from Australia, but the trade in beef bullocks from that country has not been resumed. This trade was suspended more than two years ago on account of the long time en route, losses by disease after arrival in the Philippines, popular prejudice against the heavy quarters produced by Australian bullocks, and the fact that the animals are unsuited for work purposes. As these conditions still exist, and in view of the fact that large quantities of Australian frozen meats are being imported for the Army and for sale to the general public, especially in Manila, there is probably no occasion for resuming the trade.

LIVE-STOCK DEPOTS.

The establishment of live-stock depots for the principal ports of entry in the Philippine Islands has assumed definite form during this fiscal year. Under the appropriations granted last year it was impossible to do anything of practical value in this direction except to investigate the conditions existing and work to secure adequate appropriations for this purpose.

The first effective measure adopted was the passage of Act No. 1827, appropriating ₱100,000 for the suppression of animal diseases. From this amount the current expenses of the increased veterinary force were paid to the end of the fiscal year, an allotment was made for increasing the capacity for the manufacture of serum, and a sufficient amount set aside for the construction of suitable live-stock depots for the storage and quarantine of imported animals arriving in the ports of Iloilo and Cebu.

Act No. 1855 appropriated ₱150,000 for the purchase, filling, and preparation of land in Manila, Iloilo, and Cebu on which to erect live-stock depots and quarantine stations. The bulk of this money will be required for Manila. The old Spanish experiment station, "La Granja Pequeña," will be used as a site for the Iloilo depot, and land will be secured later for the depot at Cebu.

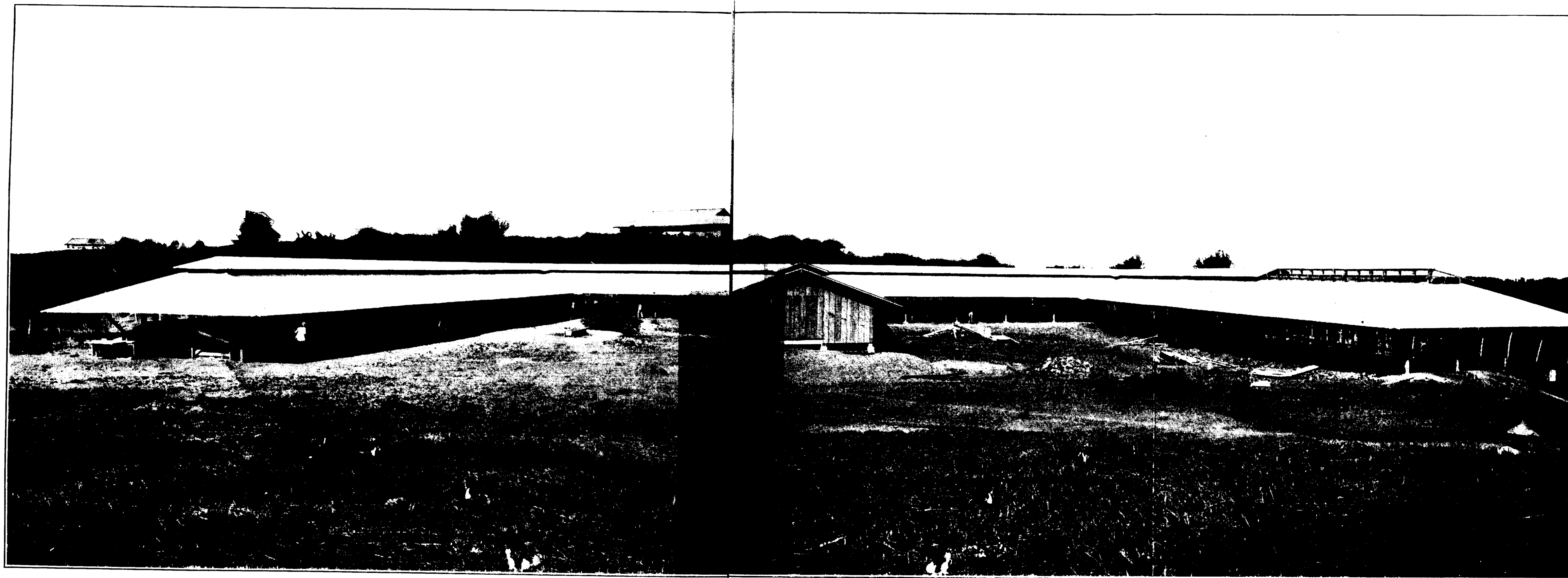
The Public Improvements Act (No. 1837) provides the sum of ₱103,000 for boring an artesian well, constructing the necessary buildings for the storage of animals, and for a forage factory in the Manila live-stock depot.

All of these appropriations taken together give about ₱280,000 to be expended in providing permanent facilities for the control of infective animal diseases. It is planned to construct all three of these depots and have them in full operation by the end of the coming fiscal year.

The value of these live-stock depots as an aid in the control of infective animal diseases in these Islands is incalculable. The provision for their construction is one of the most important moves ever made in the attempt to free this country from the ravages of infective animal diseases.

SUBSTATIONS.

The establishment of the substations to deal with local shipments of infected cattle, as recommended in the last annual report, was found impracticable until after the establishment of live-stock depots in the ports of entry. However, at the close of the year, we have in operation eleven small substations in the vicinity of Manila at which this Bureau



PLATATTLE SHEDS, ALABANG.

maintains systems of veterinary inspection and quarantine, with a view to limiting the spread of diseases through this port of entry.

IMPORTATION AND MOVEMENT.

There has been considerable increase in the live-stock trade carried on during the past year especially in the importation of cattle. The receipts for the port of Manila were as follows:

Kind.	From foreign ports.	From inter-island ports.
Cattle	37,815	2,820
Carabaos	1,750	1,298
Horses	2,170	1,862
Hogs	38	54,237
Sheep	8	186
Goats	10	841
Other animals	29	368
Total	41,820	61,612

The bulk of these animals were disposed of as follows:

Kind.	Slaughtered.	Shipped to provinces.
Cattle	26,090	10,949
Carabaos		1,711
Horses		407
Hogs	58,119	230
Sheep	10	26
Goats	368	26
Other animals	3	23
Total	84,590	13,372

The difference between these two tables is accounted for largely by sales made in the city of Manila for draft purposes, deaths in the corrals, and animals on hand at the end of the fiscal year.

Of the imported cattle arriving in Manila, 20,786 head were from Hongkong; 376 from Hai How; and 16,600 from ports of Indo-China. There were also received from Indo-China 1,750 head of carabaos. Of these, 12,978 head arrived at this port suffering from or exposed to infective diseases. All except three shipments of the infected and exposed cattle came from Hongkong, and were infected principally with rinderpest and foot-and-mouth disease, and two shipments with anthrax. Of these three infected shipments one was from the Island of Hainan, China, one from Vinh, and one from Pnom Penh, Indo-China. Of the cattle and carabaos arriving in Manila in a healthy condition, 4,262 head contracted infective diseases while being held in the corrals of cattle dealers in this city.

The receipts and shipments of live stock at the port of Iloilo were as follows:

Kind.	Number received.	Number shipped to provinces.
Cattle	2,185	903
Carabaos	590	846
Horses	436	110
Hogs	3,003	34
Goats	408	39
Sheep	526	27
Other animals	57	30
Total	7,205	1,989

The system of inspection for the port of Cebu was not permanently established until February 1, 1908, hence the statistics for that port are not complete. It appears, however, that the imports were comparatively small.

DISEASES.

RINDERPEST.

As in previous years, rinderpest has continued to be the most destructive infective animal disease existing in the Islands. The situation has been greatly aggravated by the constant importation of infected shipments of cattle from Hongkong.

On account of the increase in the number of outbreaks over the previous year, it has been necessary to limit the inoculations almost entirely to herds actually infected.

During the year, 6,933 cattle and 14,072 carabaos, or a total of 21,005, were inoculated with anti-rinderpest serum. Of these, only 621, or 2.95 per cent, are reported as having died.

The percentage of animals suffering from the disease at the time of inoculation has been very large and the total number inoculated was nearly 5,000 head more than for the previous year.

The total amount of serum used in making these inoculations was 5,384 bottles of 300 cubic centimeters each.

The principal outbreaks of rinderpest have occured in the Provinces of Batangas, Pampanga, Capiz, Antique, Occidental Negros, and La Laguna. It has also appeared to a less extent in most of the other provinces.

In many cases the provincial and municipal officials have coöperated by establishing and policing systems of quarantine, and have otherwise given valuable aid in the work. This is necessary as the Bureau of Agriculture has no means for employing a force sufficiently large to do this work throughout the Islands. Besides, to do so would be a violation of the spirit of the local self-government system in general operation throughout the provinces.

FOOT-AND-MOUTH DISEASE.

This disease has not been observed to any extent in the Philippines for more than two years. The few cases seen in Manila from time to time were no doubt due to direct importations from Chinese territory. It was reintroduced in shipments arriving in Manila from Hongkong during March, 1908. Every shipment of cattle received from Hongkong from that date to the end of the fiscal year was infected with this disease. Foot-and-mouth disease reached Iloilo and Cebu in other shipments about the same time. It has spread to more than twenty-five provinces and important islands and has attacked thousands of cattle and carabaos. It has not been, in most cases, of a virulent type but has temporarily lamed the animals so as to unfit them for work. There have been comparatively few deaths from this disease, although many of the animals which were worked while their feet were sore have suffered very severe lacerations, many of them being rendered permanently lame.

The disease still prevails to some extent in a large part of the territory between Lingayen Gulf and the southern extremity of the Island of Luzon. It has also spread to many portions of Panay and Occidental Negros. Its ravages have been most severely felt in the corrals of live-stock dealers in the city of Manila and in the surrounding provinces. More than 4,000 head of healthy cattle and carabaos which arrived in Manila free from this disease have contracted it in this city.

There is no effectual way to prevent the spread of this disease except by a rigid quarantine.

SURRA.

During the year animals were examined for surra, as shown in the following table:

Kind of animal.	Examined.	Positive.
Horses	4,311	286
Cattle	353	------
Carabaos	315	22
Total	4,979	308

The number of animals found affected with the disease is nearly four times the number for the previous year. This does not necessarily indicate an increase in the amount of the disease, but rather shows that the disease is more often reported and diagnosis made by this Bureau.

The principal outbreaks of surra have occurred in the Provinces of Bohol, Cagayan, Tayabas (Island of Marinduque), La Laguna, Albay, and Leyte, with smaller outbreaks in other provinces and islands. This wide distribution demonstrates the necessity for thorough work throughout the Archipelago if this disease is to be completely eradicated.

EPIZOÖTIC LYMPHANGITIS.

This disease seems to affect horses throughout the Islands, but is not extensive or serious at the present time. Out of 2,188 animals examined during the year only 125 were found to be affected with the disease. An experiment was conducted at the Trinidad stock farm, Baguio, in the use of iodide of potassium in the treatment of this disease. The animals affected were three native pony mares, purchased a few months previously, and which subsequently developed the disease. One of them had it in a generalized form while the other two had only local lesions. The two latter responded promptly to the treatment, which seems to have effected a complete cure. The other was greatly improved but not cured.

ANTHRAX.

A disease resembling anthrax has prevailed for a number of years in limited sections of the mountain provinces, especially Nueva Vizcaya and Lepanto-Bontoc. An extensive outbreak of the same disease appeared in Lepanto-Bontoc in the latter part of July, 1907. A veterinarian was sent there, but he failed to see any considerable number of affected animals. Based on the post-mortems of two cattle he pronounced the disease anthrax, but subsequent evidence seemed to throw some doubt on this diagnosis.

This Bureau requested the Bureau of Science to begin the manufacture of anthrax vaccine, but before this vaccine could be gotten to the place where the outbreak occured the disease had largely disappeared. The territory in which this disease has prevailed is very difficult to reach and a large amount of damage may occur at any time unless a veterinarian is on the ground to give prompt attention to possible outbreaks.

On October 29, 1907, the steamer *Loongsang* arrived at the port of Manila from Hongkong with a cargo of cattle infected with anthrax. Landing permit for this shipment was denied, and it was returned to Hongkong. On the same date the steamer *Rubi* arrived in this port from Hongkong with a cargo of cattle reported to be infected with anthrax. As none of the cattle in this latter shipment were affected with the disease at the time of inspection, permit was given for their slaughter on board ship, and the meat was brought ashore and placed in cold storage.

GLANDERS.

This disease seems to be decreasing from year to year. Out of 590 horses examined for glanders this year only 61 were found to be positive. This, however, represents only a small fraction of the cases which actually existed, as the disease does not usually present alarming symptoms and often is not reported to the veterinarians.

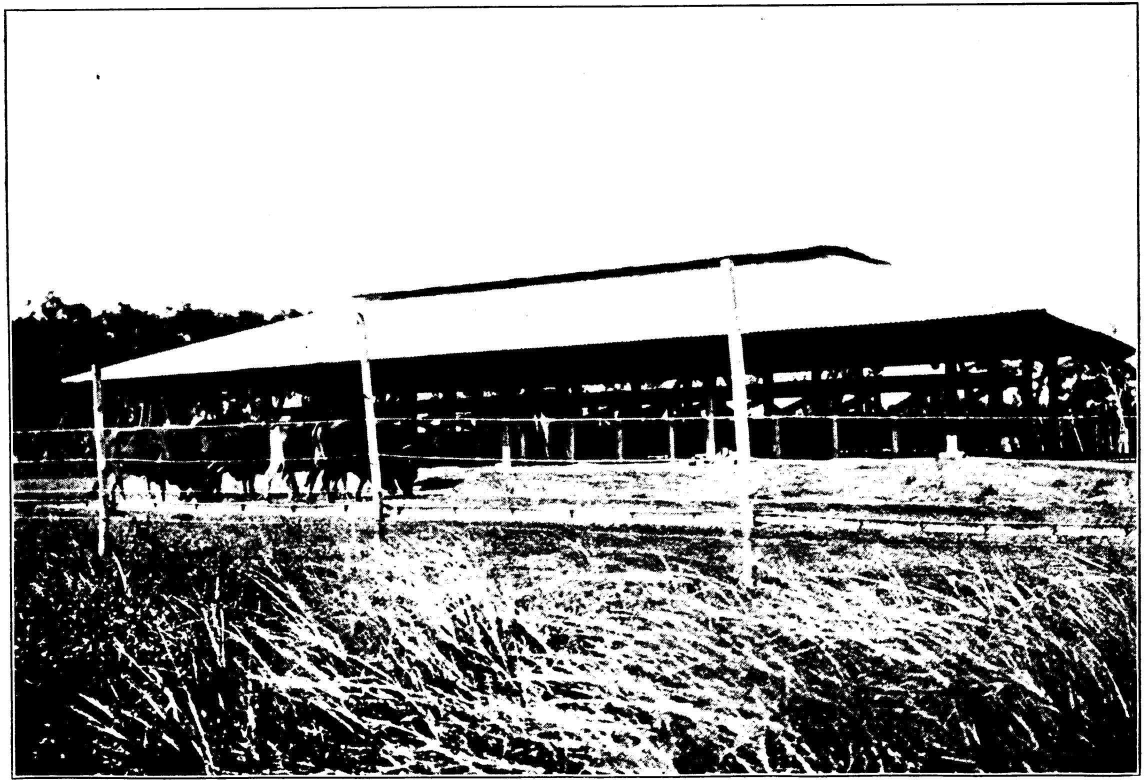


Plate V. QUARANTINE SHED, ALABANG.

HOG CHOLERA.

It appears that this disease has decreased its ravages to a considerable extent, although it still prevails in a number of provinces. It most often occurs among animals in the channels of trade, or where they are in crowded quarters. The examinations made by the representatives of this Bureau included 354 head of hogs, of which 94 were found to be affected with the disease.

MINOR DISEASES.

Some observations have been made in minor diseases, such as chicken cholera, mange of horses and dogs, etc., but no definite statistics or reports have been received which would be suitable for publication.

SERUM LABORATORY.

LOCATION AND BUILDINGS.

As stated in the last annual report, the old corral at the San Lazaro hospital in the city of Manila, now used for the serum laboratory, is entirely unfit for such purposes. During the year the buildings, sheds, and walks have gone into considerable decay on account of their temporary nature and for lack of substantial repairs, which it was not thought advisable to make, in view of the contemplated move, in the near future, to the new quarters at the Alabang stock farm.

More than half of the fiscal year had passed before contract was let for the buildings on this farm. On account of the small appropriation available for this purpose great difficulty was experienced in securing a contractor. The Bureau of Agriculture finally took over all of the work except the reënforced concrete laboratory building, and has made every effort to push the work to completion. Serious and apparently unavoidable delays in securing materials and laborers were encountered. For these and other reasons the work was not half completed at the close of the fiscal year. In view of the early advent of the rainy season it will not be possible to complete the buildings and get the grounds in proper condition for the removal of the serum herd there before the end of the first quarter of the coming fiscal year.

SERUM HERD.

On account of our inability to move into the new quarters, where it was expected to double the serum herd, the number of animals used for serum production during the past year has not exceeded 120 head at any time. This resulted in a constant shortage of serum, which was severely felt on account of the great demand for serum in dealing with the large number of outbreaks of rinderpest encountered in the provinces.

The serum cattle have been in excellent condition during most of the

year except for a general outbreak of foot-and-mouth disease among them about the first part of April. Practically all of the animals contracted this disease and a few of them suffered severely. Most of them recovered promptly after a few days' treatment, and the decrease in the amount of serum produced was felt only during the months of April and May.

Some difficulty has been experienced in introducing new bullocks into the herd on account of the great prevalence of rinderpest among shipments received in Manila from Hongkong, where most of our serum bullocks are obtained. This was greatly aggravated by the appearance of foot-and-mouth disease, which causes many deaths when it occurs as a complication with rinderpest. This resulted in raising the death rate among the bullocks immunized to more than 10 per cent, which is double the death rate which would normally prevail. The most serious effect, however, of this combination of diseases, was in connection with the vaccine calves where the death rate reached 25 per cent.

PRODUCTION OF SERUM.

The amount of serum produced during the year was 1,800.9 liters, or sufficient to make about 5,400 bottles of 300 cubic centimeters each, The process of centrifugating and filtering the serum, introduced January 1, 1907, has been continued throughout the fiscal year. This system results in a sterile serum which is vastly superior to the unfiltered product.

Two additional improvements of considerable consequence in the production of serum have been made during the past year. From four to eight liters of normal salt solution were injected into the peritoneal cavity of virulent blood animals two hours before bleeding them. After the animals had been bled to death this saline solution was recovered and seems to possess all the virulent properties of the blood itself. This has the effect of more than doubling the amount of virulent fluid obtained from each animal, and consequently saves half of the expense formerly incurred in providing virulent blood.[1] This process was practiced on 67 head of cattle, from which 338.5 liters of virulent peritoneal fluid were obtained, or an average of 5.58 liters per animal.

The serum made from bullocks injected with this material has been thoroughly tested by the Bureau of Science and is reported to have more immunizing power than the serum made from bullocks injected with virulent blood.

In view of these facts all cattle used for the production of virulent

[1] For a detailed account of this method see the article "*Etudes Sur la Peste Bovine*" by MM. Nicolle and Adil-bey, in "Annales de l'Institut Pasteur," Vol. 15 (1901), pp. 715–733; also see references in the "Philippine Agricultural Review," vol. 1, No. 5, p. 204, and in the Annual Report of the Secretary of the Interior to the Philippine Commission, June 30, 1908, pp. 46 and 68.

material hereafter will be injected with the saline solution for use as above indicated.

The other notable improvement in the production of serum was in shortening the time between the immunization of bullocks and the beginning of their use for the production of serum. Under the old process they were given successively 1, 5, 10, 25, 50, 100, 250, 500, and 1,000 cubic centimeters of virulent blood at intervals of from three to ten days. By this process not less than eighty days were usually required to bring the bullock up to where it would begin to produce serum. The new process consists of injecting successively 1, 10, 100, and 1,000 cubic centimeters of virulent blood or fluid, at the same intervals, the whole process covering a period of only forty days, at the end of which time the bullock begins to produce serum. The serum produced by this method was found to have as much or more immunizing power than that produced by the old method. It has given excellent satisfaction in the provincial work conducted extensively throughout the Islands.

VACCINE CALVES.

The Bureau of Agriculture has continued to furnish calves to the Bureau of Science for use in the manufacture of smallpox vaccine for the Bureau of Health. Many obstacles were met with during the year in securing a satisfactory supply of calves. With increased prevalence of rinderpest, which is particularly destructive among calves, their shipment to Manila was gradually suspended. Dealers would bring them in only on special order and then a whole shipment was often found infected with the disease. It was found practically impossible to save those in the advanced stages of the disease and, as above stated, the death rate has been correspondingly high.

One cattle dealer who desired to import heifer calves with which to stock a farm, proposed to furnish them to the Bureau of Agriculture to be used as vaccine calves with the understanding that all expenses of immunization and keep would be defrayed by the Government and that he would stand all losses resulting from death. Under this arrangement he furnished 52 calves of which 35 were infected when received. Thirteen of these died, ten from rinderpest, and three from combination of rinderpest and foot-and-mouth disease.

IMMUNIZATION.

Only 82 head of cattle were accepted for immunization during the year, of which 30 were grade Spanish cows with calves at foot or pregnant. These were purchased by the Bureau of Agriculture for an experiment in the inoculation of this class of cattle and with a view to their subsequent use as breeding stock. Of these one died from injury in shipment, eleven aborted when the symptoms of rinderpest appeared, and seven of these died.

An Australian cow from Sydney with calf at side, dropped in Manila, were submitted for immunization. As both were not immune to tick fever the symptoms of this disease developed just as they were recovering from rinderpest and both of them died.

Of the animals received for immunization sixteen were carabaos one of which died. The loss among animals submitted for immunization was 12½ per cent. This is much higher than the loss which would ordinarily be sustained, on account of the large number of infected animals which were submitted rather for serum treatment than immunization, and the large number of these cases complicated with foot-and-mouth disease.

TRINIDAD STOCK FARM.

This farm was in charge of Mr. A. S. Ashe until January 7, 1908, at which time he resigned and Dr. C. M. Morgan, a veterinarian of this Bureau was placed there.

LOCATION.

This farm is located in the Little Trinidad Valley, 6 kilometers north of Baguio. Being at a high elevation the climate is well suited to the American horses kept for breeding purposes.

WATER SUPPLY.

The water for the stock is secured from a small spring near the barns, but during very dry seasons it does not furnish enough water for the stock. If the number of stock kept there is to be increased some means will have to be devised to secure a water supply from a small river which is back of a ridge from the house.

OPERATIONS.

Considerable attention has been given during the year to the establishment of permanent pasture grasses in lieu of the native grasses which die so readily during the dry season. A number have been planted, including Guinea grass, *Paspalum dilatatum*, red clover, Dutch clover, oats, and Bermuda grass. The latter has given by far the best results as a pasture, while oats in the warmer season promise heavy yields of green forage.

The work on this farm has continued along the same lines mentioned in the last annual report. The lines of breeding include American and native horses, native cattle with imported bulls, Shropshire sheep, and Angora goats.

About 100 acres of unoccupied public domain in the Trinidad Valley adjacent to the Trinidad farm were fenced in to be used as a breeding pasture for outside stock. The plan has been to put pregnant mares

PLATE VI. SUPERINTENDENT'S HOUSE, ALABANG.

and cows in this pasture and as soon as they have foaled or calved they were bred to the American sires kept at the farm by this Bureau. It is this system which is largely responsible for the increased amount of breeding during the year.

LIVE STOCK.

One of the notable features has been the increased interest taken by the natives, especially the Igorots, in breeding their pony mares to the imported stallions kept at this farm. The number of mares bred increased from about ten per month in October to more than seventy per month in March, which numbers include return services.

In this connection the superintendent of the farm has castrated about 100 native stallions. If continued a few years this will permanently establish the custom of castrating the native ponies instead of working them as stallions.

The live stock on hand at the end of the year consisted of 4 imported stallions, 11 imported mares, 27 native mares, 17 colts (American half-breeds and native) over one year old, 15 sucklings, 16 mature burros, 6 burro colts, 1 American jack, 2 imported bulls, 2 grade bulls, 34 native cows, 11 steers, 11 heifers, 9 work bullocks, 21 calves, 4 Angora goats, and 10 Shropshire sheep.

All of this stock has kept in good condition and the losses by accident, such as falling over cliffs, has decreased as compared with former years.

During the year two American thoroughbred colts have reached maturity and have been broken to harness. While they are not of ideal type, they are the first production of the farm, and show the possibility of raising horses in this vicinity. A number of colts of pure American blood, half-breeds sired by Morgan or Arabian stallions out of native mares and a few full native colts are coming to maturity and will be broken to harness during the coming fiscal year. They appear promising and it is to be hoped that some of them will prove valuable breeding stock for the future work of this Bureau.

The burros which did very badly for the past two years seem to be doing much better now. The large jack from Missouri is being used on some of them in the hope of breeding smaller-sized jacks suitable for mule breeding with the native mares in these Islands.

The native cows bred to Calloway and Devon bulls have produced a good crop of calves of which we now have three generations at this farm. A few of the older heifers have reached breeding age, are strikingly like their sires and are being bred to imported bulls. As soon as this class of cattle increases sufficiently the original native cows will be sold.

The Angora goats imported from Australia have continued to do well. They have been provided with shelter and have not shown the bad effects of the rainy season like native goats. It is intended to purchase a

supply of native females and add to the flock during the coming year, with the view to breeding a large number of grades for distribution in the provinces.

The sheep imported from Australia have not thrived quite so well as the goats, but have done much better than the native sheep, probably due largely to the shelter and attention given them. They have suffered from time to time with ulcers on their heads, flanks, and other exposed portions of the skin, probably due to the irritating effect of biting insects.

ALABANG STOCK FARM.

This farm has been in charge of Mr. H. N. Knight since it was opened on December 30, 1906.

LOCATION.

This farm is located at Alabang on the Batangas line of the railroad, 22 kilometers from Manila. Three trains each day make it of easy access from Manila.

SOIL.

The soil at Alabang is composed of a stiff clay which is rather difficult to work. It is underlaid with a soft shaley rock.

WATER SUPPLY.

Water for live stock was obtained during the past year by pumping from a small stream which runs through the farm near the buildings. During the dry season this water becomes very foul and it is thought that this bad water was the cause of the death of some of the calves during the dry season.

An 8-inch artesian well is being drilled which will furnish sufficient pure water for all purposes in the future.

OPERATIONS.

As this farm was intended primarily as a site for the serum laboratory every effort was made to have the required buildings constructed with the least possible delay in view of the failure to secure their erection the previous year.

As previously stated, this work has been very greatly delayed and at the close of the year it appears evident that more than three months longer will be required before the serum herd can be moved into the new quarters.

A large part of the work done on the farm during the year has been in the transportation of building materials, the quarrying of stone, the building of roads and fences, and the erection of buildings for which

this Bureau accepted contract from the Bureau of Public Works. But little attention has been devoted to bringing the land into cultivation with a view of production of forage crops, or to conducting regular field experiments, on account of the pressing demands in other directions.

Most of the land is covered with a dense growth of cogon and talahib grasses, beside other rank weeds and has not been in cultivation for more than ten years. The small plats, which had been cultivated in rice up to the time this Bureau acquired the property, had been puddled according to the native method; consequently, the clearing and breaking of the land with a view to planting crops has proved a very difficult task.

It was intended to use a steam plow on this work, but some necessary repair parts were not received until near the beginning of the rainy season. A petroleum plowing engine was secured about the same time and a small amount of work was done with it. This has resulted in a comparatively small area being planted during this year. A piece consisting of about 2½ hectares was plowed in January and allowed to lie through the dry season. In June it was thoroughly disked and harrowed into good condition. It was then thrown up in beds 1 meter wide with a liberal application of complete fertilizer and planted with white velvet beans. As soon as these have reached maturity they will be rolled and turned under with a disk plow with a view to restoring the wasted organic matter in the soil.

Among the other forage crops successfully grown have been teosinte, sorghum, and broom corn. The very foul condition of the land and the fact that it has been greatly impoverished in places by the native method of cultivating rice, have been serious obstacles in the way of securing adequate crops. Both the mechanical and chemical conditions of the soil must be greatly improved before satisfactory results can be expected.

An experiment was made in the planting of nursery-grown trees in the fence line around the border of this farm with a view to ultimately using them as growing fence posts. Among the trees planted were kapok, Australian beef wood, eucalyptus, and rain tree (*Pithecolobium saman*). As the land where most of these trees were planted was very foul, and the plantings made mostly in the heaviest part of the rainy season with an unusually severe dry spell immediately following, a large number of the trees died, but those which survived these conditions seem to be doing quite well. During the latter part of the rainy season kapok trees will be set out on all the fence lines. It will demand considerable labor for several years to protect them from fire, but if they can be saved they will furnish us with permanent fence posts.

LIVE STOCK.

The live stock on the farm at the close of the fiscal year was as follows: 1 imported stallion, 10 imported mares, 2 native stallions, 14 native mares, 11 colts, 1 jack, 1 mule, 22 imported cows, 7 grade cows, 16 native cows, 32 calves, 2 imported bulls, 19 work bullocks, 7 Chinese heifers, 1 imported boar, 5 imported sows, 8 pure-bred pigs, 21 native hogs, 5 imported male goats, 24 imported female goats, 20 native goats.

HORSES.

It was not intended to begin horse-breeding work at this farm before it was fully equipped with buildings, water supply, paddocks, and pastures. However, a surplus of stock began to accumulate in Manila and at the Trinidad stock farm, which was sent to Alabang because of the available pasturage, and the tendency has been to constantly increase the number of horses there without particular reference to their selection for breeding purposes. In fact, some of the stock at this farm is in bad condition and will have to be condemned. The colts born there are thriving well, although the mothers get a large part of their feed in the pasture.

There is now a pressing demand for an outlet of surplus American horses from the Trinidad farm and arrangements have been perfected for the transfer of 52 head of mares and colts to this Bureau from the Army. In view of the uncompleted condition of the building equipment at this farm we are totally unprepared to care for all of this stock up to the close of this year.

CATTLE.

The dairy herd has been the most important line of work maintained at this farm during the year. The cattle have kept in good condition while being pastured on the native pasture grasses. During a part of the dry season it has been found necessary to supplement this grass with some concentrated feed. More calves have been raised this year than last. This probably is due to better pasture conditions as well as to care. They have been given a liberal supply of milk which has made the amount furnished the Civil Hospital less than it otherwise would have been. During the dry season an epidemic of scours broke out among the calves which was attributed to the bad water from the creek. They have now recovered, however, and are looking well.

The total amount of milk furnished to the Civil Hospital from the dairy farm was 2,709 gallons.

A large number of native cattle on hand at this farm consists of Chinese calves which had been used by the Bureau of Science in the production of vaccine and were sent to this farm instead of being sold. This class of stock shows a great adaptability to conditions which prevail there and keep in excellent condition on the native grasses.

PLATE VII. SMALL-ANIMAL HOUSE, ALABANG.

GOATS.

The imported goats are thriving very well, living almost entirely upon the grasses found in the low lands. Seven half-breed young males have been sent out during the year to be used in crossing on native goats. Good results are being obtained by crossing our Maltese males on the native goats.

HOGS.

One of the most satisfactory branches of live-stock breeding at this farm is that of Berkshire hogs. They thrive well and breed regularly. Thirty young pigs have been sent away and eight are being raised to replenish our own breeding stock.

Boars have been loaned to parties in Biñan, Santa Rosa and Calamba.

Some experiments have been started in pig feeding, to investigate the cost of growth, maintenance and fattening with various native feeds.

Twenty pigs weighing from 18 to 30 pounds were obtained in the vicinity and tiqui-tiqui, corn, and copra meal are being used in feeding. The experiment is still running and it is impossible to give a report at this time. As the native hog is much slower in coming to maturity and putting on flesh, investigation of this kind will take considerable time.

Some feeding was done to determine the effect on the quality of the lard, obtained by feeding copra meal Two pigs are being fattened on ground corn and three on copra meal. The copra-fed hogs are fattening much more slowly than those receiving corn.

It has been observed that young pigs will eat clear copra meal almost as soon as it is offered them, but older ones have to be nearly starved before they will start eating it.

A full report of these feeding tests will be reported when the feeding is completed.

Owing to the fact that the present hog quarters are so muddy and unsatisfactory during the wet season it will be necessary to build as soon as possible a house of sufficient size to accommodate at least twelve brood sows, with pigs and two mature boars.

SMALL ANIMALS.

During the month of May, the Guinea pig and rabbit breeding work formerly carried on by the Bureau of Science and transferred to this Bureau January 1, 1908, was removed to this farm. A light material house of suitable size had been constructed and these small animals appear to be doing much better there than they were at the former location at the San Lazaro Hospital. The quarters are located on a high rocky hill where it is dry and the buildings get the benefit of the breezes from every direction.

The green forage required for feeding these animals is now produced on the farm instead of being purchased from contractors, as was formerly done in Manila.

POULTRY.

No plans have yet been perfected for starting poultry work, but this will probably be undertaken during the coming year.

GENERAL STOCK-BREEDING WORK.

It is now almost five years since this Bureau commenced furnishing stallions, bulls, boars, and other animals for breeding purposes in the provinces, by loan, sale, or otherwise. It has been constantly observed that the average person in the provinces takes little interest in the improvement of his live stock. There is no well-defined line of breeding, and the only premium of material value for improvement in this direction has been the high prices paid for racing ponies. Even this has failed to impress most of the populace with the necessity for carefully selecting sire and dam with a view to producing a speedy pony. The race horses that are winning on the tracks in the Philippines are for the most part pure accidents, as most of them have been bred on the range and their sires are unknown.

It is customary now when a consignment of ponies reaches Manila for the owner to try each of them or have them tried by some track man, with a view to finding out if there are any among them that are promising for the track. However, a definite point of value, especially with reference to horses, has been presented during the past year. A three-year old colt out of a native mare 51 inches high, and sired by an Arabian stallion formerly owned by the Bureau of Agriculture, was brought to Manila and sold for ₱1,600. He showed at a glance to be far superior to even the best average racing pony and his present value is probably many times the price paid by the purchaser. Soon after this colt was sold, another one out of a native mare and sired by a Morgan stallion changed hands at something over ₱1,000. Both of these colts were bred in Batangas Province and demonstrated to the owners of mares that as a business proposition it would prove profitable to breed to improved stallions. There was a corresponding demand for stallions in the Province of Batangas, and as such demand did not exist elsewhere a representative of this Bureau with the necessary help was sent to Batangas Province with three stallions and instructed to make a regular campaign through the principal horse-breeding sections there.

As a result, one of the stallions has had 79 services, one 64, and one 60, making a total of 203. This is more than all of the services formerly rendered by all of the stallions sent to that province by this Bureau during the past four years, and was accomplished in a period of less than eight months. Should a reasonably large per cent of the mares drop and raise foals it will mean a great boon to the horse industry of

Batangas Province. It will also greatly stimulate horse-breeding throughout the Islands, as Batangas is looked upon generally as the leading horse-breeding province of the Archipelago.

The next largest service list was 52 by the stallion Montgomery Chief, used for breeding draft mares at the city stables in Manila. The total number of services rendered by the remaining 7 stallions was 349, making a total of 604 for the 11 stallions in service.

The imported Australian bulls immunized against rinderpest have continued to do very poorly. Four additional bulls were imported from Townsville, Australia, with special instructions to secure them immune to tick fever. They were received during the month of May, and were carefully guarded against rinderpest and foot-and-mouth disease. When exposed to ticks two of them promptly died from the effects of tick fever and the other two are in rather poor condition.

Much better results have been obtained from the young half-breed Galloway bulls bred at the stock farm and sold or loaned to breeders in that vicinity.

The demand for breeding pigs continues unabated and this Bureau is quite unable to meet the demands in this direction. A number of private parties have been induced to go into the pig-breeding business and have been offering for sale a considerable number of pigs having more or less improved blood in them. These pigs sell readily at any time. This is one of the most promising lines of stock breeding which has been tested by this Bureau and gives prompt returns.

A number of full-blood and half-breed male Maltese goats have been sold or loaned to parties in the provinces for breeding purposes. Two of the full-blood goats died, but the results have been generally quite satisfactory.

However, under existing conditions of disease among animals in the Philippines, there is not satisfactory encouragement for investing money and time in this business. Breeding can not be restored to its proper position among the agricultural industries until such severe diseases as surra, rinderpest, and hog cholera are under better control, and investments in stock breeding made correspondingly secure. The importance of accomplishing this result is particularly felt in the breeding of cattle and carabaos, which are so extensively used for draft purposes all over the Islands and determine largely the amount of products sold by the farmers of this Archipelago.

Very respectfully,

G. E. NESOM,
Director of Agriculture.

The Honorable,
the SECRETARY OF THE INTERIOR,
Manila, P. I.

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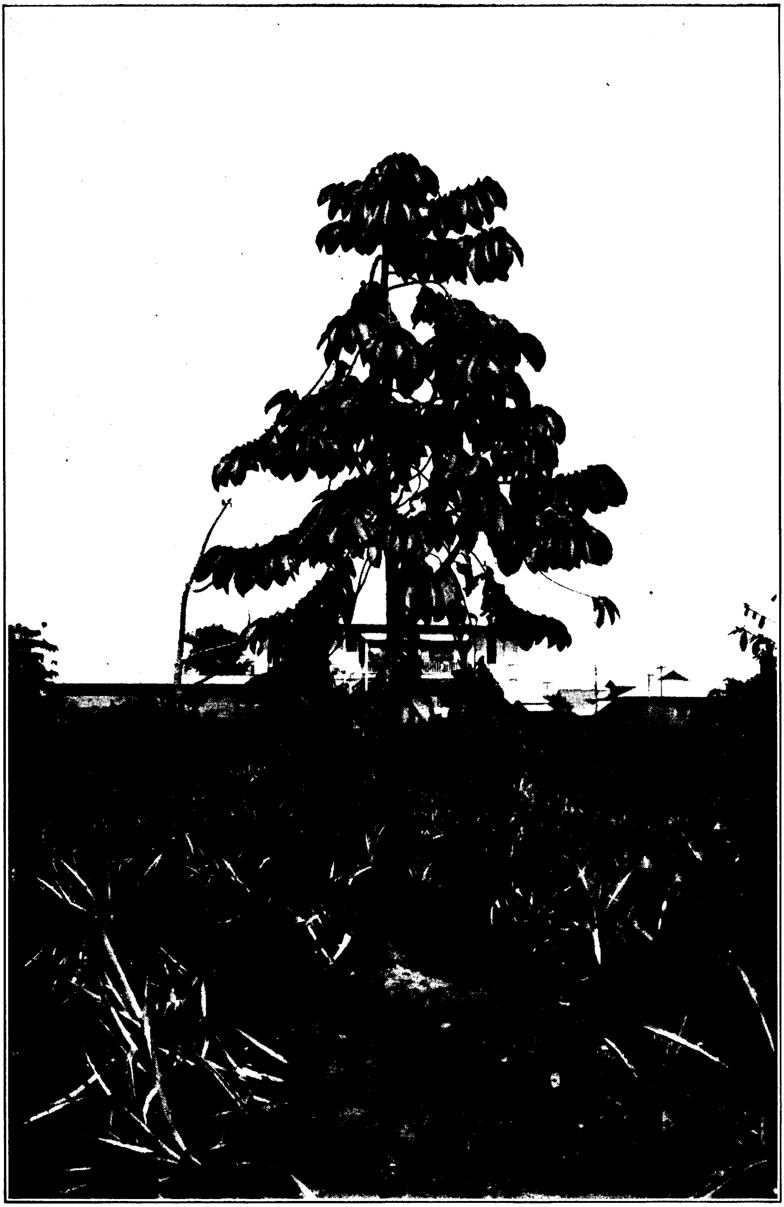

PLATE I. CASTILLOA RUBBER TREE, SINGALONG EXPERIMENT STATION, MANILA.

THE PHILIPPINE

Agricultural Review

VOL. II FEBRUARY, 1909 No. 2

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

RUBBER.

Interest in rubber planting in the Philippines is increasing steadily. Rubber is a crop which, once brought to the producing stage, increases in value from year to year. It is also a crop that does not need to be harvested when the price is low or labor scarce. There are vast areas in these Islands that are adapted to rubber growing, and the industry should receive more attention than is being given it at the present time.

The best methods for growing rubber have not yet been very definitely determined, as have those for growing many other more common farm crops. Opinions differ widely, not only as to the best kind of rubber to plant, but also as to the method of handling any particular kind of rubber after it has been planted. Hence the literature on this subject is still in a formative stage. Much that has been written in the past on the subject of rubber planting has been written for some other purpose than that of giving the facts, as for instance the exploiting of some rubber plantation that has stock for sale. Reports from men of unbiased opinions are obtainable, however, and should be carefully studied by those who intend to invest or who are in any other way interested in rubber growing.

The varieties of rubber grown for commercial purposes are, practically, three in number: (1) Para (*Hevea braziliensis*); (2) Castilloa (*Castolloa elastica*); (3) Ceara (*Manihot glaziovii*). All three varieties are grown more or less in these Islands, Para and Castilloa being particularly adapted to the southern islands where the rainfall is more evenly distributed. Ceara will thrive in the northern islands, for it grows well in higher altitudes and is better able to withstand drought than the other varieties. It has two defects, however; first, it is easily broken by high winds, and, second, it is difficult to tap. Experiments are being conducted to ascertain methods by which the difficulties encountered in tapping may be overcome, and considerable progress is being made. The Hawaiian Experiment Station has published an interesting account of some experiments conducted there along this line, and makes some very valuable suggestions which are being reproduced in this number of the REVIEW.

The main article in this issue, written by Mr. Fred T. P. Waterhouse, treats of Para and Ceara rubber. It is the purpose of the editors to publish in the REVIEW from time to time articles written by men who may be considered authorities on this subject, dealing with the phases of rubber growing in different countries, in order that the readers of the REVIEW may have an opportunity to study the methods followed in the various rubber-producing regions.

REPORT ON THE CULTIVATION OF RUBBER IN CEYLON, THE FEDERATED MALAY STATES, AND JOHORE.

By Fred T. P. Waterhouse.[1]

The cultivation of rubber trees is being extensively carried on in Ceylon, the Federated Malay States, Borneo, and Java. In these countries greater advance has been made in rubber cultivation than in any other part of the world. Virgin forests are being felled, cleared, replanted with rubber trees, and brought into bearing at a cost of from $100 to $150 (U. S. gold) per acre, while commercial rubber is produced and placed on the London market at a cost of from 24 cents to 36 cents per pound, including capital cost. The tapping of rubber trees and the method of collecting and handling the latex from the trees in a systematic and economical way is only in its infancy. As time goes on and large areas of trees come into bearing, and with the experience gained, the cost of collection should be materially reduced. The problems yet to be solved are: How old or how large the trees should be before they are ready for tapping; how to reduce the amount of bark cutting without loss; how often and for what length of time it is best to rest the trees; whether to use the single "V" method of cutting the bark, the herring-bone, or some other system. There are also the questions of whether or not it is best to cut the trees on both sides at the same time or alternately; the frequency of tapping and its effect on the quantity, richness, and strength of the rubber; the number of trees most profitable to plant to the acre, etc. I found a difference of opinion as to what tapping tools were best to use and the method of treating the latex. One question appears to be settled, however, and that is that in this part of the world the Hevea is the most satisfactory tree to plant and is being planted almost exclusively.

[1] Mr. Fred T. P. Waterhouse, as a representative of the Board of Agriculture and Forestry and the Hawaiian Rubber Growers' Association, Territory of Hawaii, made a trip to Ceylon and the Malay Peninsula for the purpose of investigating and reporting upon the status of the rubber-growing industry in those countries and methods of planting, cultivating, tapping, and treatment of rubber trees in use there. As his report would be of interest to those contemplating rubber growing in the Philippine Islands, we reproduce a portion of it, as published in the Hawaiian Forester and Agriculturist, Volume V, No. 11.

It grows well, is hardy, and will stand a great deal of abuse, while the cost of gathering the latex is less and the profit consequently greater with this variety than with any other. The annual yield of rubber per acre is greater than with other varieties. Ceara is planted to a very small extent in parts of Ceylon on the higher elevations where Hevea does not do so well. Ficus elastica was planted to quite an extent at one time but is now being abandoned or cut out. Castilloa does not do well as it grows very slowly.

HEVEA OR "PARA" RUBBER.

Hevea or "Para" rubber does best where the temperature does not go below 60°, but localities where the temperature does not go below 65° are preferred. The temperature in Malaya and Ceylon does not vary more than four degrees between the cooler and warmer months. The climate is very humid. January is the coolest month, while March is the warmest. The following table shows the weather reports for the months of April, 1907, to March, 1908, inclusive. These readings were taken at Kuala Lumpor, State of Selangor, F. M. S., which is about the center of the largest plantings in Malaya:

Month.	Mean barometrical pressure at 32° F.	Maximum in sun.	Temperature.				Hygrometer.				Prevailing direction of winds.	Total rainfall.	Greatest rainfall during 24 hours.
			Mean dry bulb.	Maximum.	Minimum.	Range.	Mean wet bulb.	Vapor tension.	Dew point.	Humidity.			
1907.													
April	29,814	145.3	81	91.1	71.6	19.5	76.5	0.832	73.7	78	Calm	12.69	2.48
May	29,883	149.2	80.8	90.5	71.8	18.7	76.5	.830	73.6	79	Calm	7.55	2.53
June	29,883	147.6	80.3	90	71.1	18.8	76.1	.819	73.2	78	SW	7.44	3.56
July	29,872	147.1	80.5	90.4	71.3	19.1	76.3	.825	73.4	79	SW	3.37	.90
August	29,884	150.8	80.9	90.3	70.6	19.7	76.2	.818	73	77	SW	.72	.72
September	29,822	147.8	80.7	90.7	70.9	19.8	76.5	.833	73.7	79	SW	6.69	1.26
October	29,874	141.3	79.4	89.5	70.7	18.8	76	.840	73.6	83	SW	12.38	2.43
November	29,881	149.8	80.3	89.3	71.1	18.2	75.8	.810	72.9	78	SW	7.73	1.50
December	29,877	137	78.9	89.3	70.2	19.1	75.8	.828	73.7	84	SW	18.92	3.65
1908.													
January	29,875	147.2	80.9	90.5	71.1	19.4	76.6	.839	73.8	79	NW	7.71	5.20
February	29,883	149.6	80.8	90.1	70.6	19.5	75.6	.807	72.9	77	Calm	14.01	3
March	29,880	143.9	80.2	89.8	70.8	19	76.8	.820	73.5	79	SW	10.10	2.67

The rainfall in the countries visited is very great and well distributed over the year. Para seems to do best in districts where the rainfall is from 70 to 150 inches per annum. An experiment with irrigated Para trees is being carried on at the present time in Ceylon in a district where there is little rainfall and in a locality where the trees are exposed to the wind which tends to wither the leaves. Irrigated trees in dry districts would in all probability do well if they were protected from the wind. There are no strong winds in the rubber districts, the wind

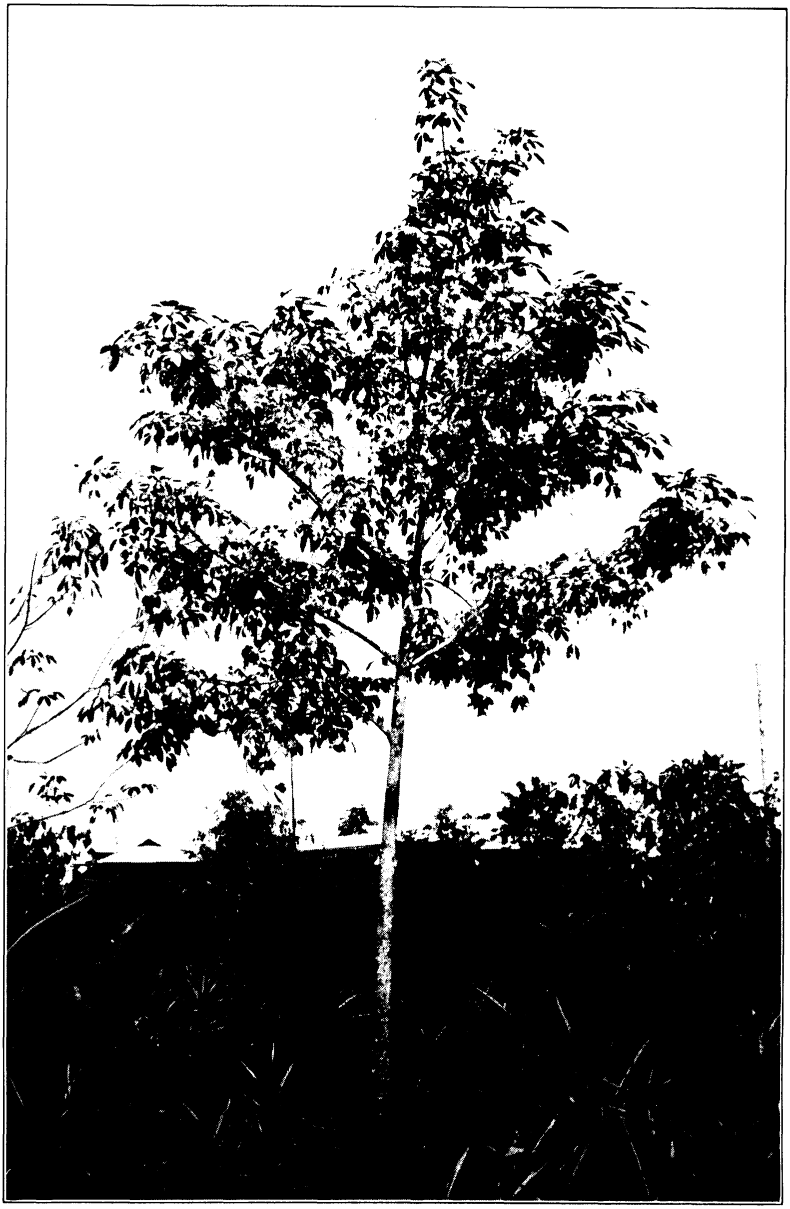

PLATE II. PARA RUBBER TREE, SINGALONG EXPERIMENT STATION, MANILA.

seldom exceeding a velocity of 20 miles an hour below the 3,000 feet altitude. Flat low land was originally preferred for rubber plantations but rubber does equally well in rolling or hilly country. The elevation at which most of the rubber is planted is below 200 feet. The thirty-year-old Hevea trees at Peradeniya at an elevation of 1,500 feet above the sea level, however, show an excellent growth. The soil in Malaya is alluvial and in some localities mixed with a moderate amount of sand. Sandy soil, however, is unsuitable while rocky soil is generally favorable. The following gives the analysis of some of the soil in Ceylon. I quote from Circular No. 6, Volume III, of the Royal Botanic Gardens, Ceylon, a copy of which was kindly furnished me by Dr. Willis:

CEYLON SOILS IN WHICH RUBBER IS PLANTED.

It is obvious that since Para rubber has been planted from sea level up to 2,000 feet in districts such as Galle, Baddegama, Kelani, Ambalagoda, Kalutara, Ratnapura, Polgahawela, Veyangoda, Kadugannawa, Peradeniya, Matale, Kurunegala, Badulla, and Passara, there must necessarily be considerable variation in the chemical and physical properties of the soils now under this product.

The land in rubber is, in the south of the island, mainly flat; here and there steep, rocky hillsides similar to what one sees up-country are planted in rubber, but one has to leave the south of the island and go to the Central and Uva Provinces in order to see large areas of rocky, hilly land planted with this product. In many districts the alluvial soils along the banks of rivers have been planted, in most cases below flood level, so that the conditions of the Amazon valley are to some extent imitated.

Experiments have been commenced in dry but irrigable areas. The want of rain in proper proportions and quantities may prevent the extension of rubber in the northern part of the island, where only the northeast monsoon is felt and where the annual rainfall varies from 40 to 60 inches.

The soil types in which Para rubber is being cultivated may therefore be roughly divided into the following:

1. Cabook.
2. Alluvial soils.
3. Tea and cacao soils.
4. Swamps.

The cabook soils are met with as local areas in many districts. They are usually inferior from a chemical and physical standpoint, though in many cases the growth of the rubber trees appears to be satisfactory. Such soils usually show a small percentage of organic matter, potash, phosphoric acid, and lime. A typical example shows the following composition:

Analysis of typical cabooky soil.

[Mechanical composition.]

	Per cent.
Fine soil passing 90-mesh	11.50
Fine soil passing 60-mesh	9.50
Medium soil passing 30-mesh	4.00
Coarse soil and small stones	75.00
	100.00

Alluvial soil.—For physical properties these soils are usually good, and the amount of sediment periodically deposited during floods adds considerably to the chemical richness of the soil.

They are largely composed of the lighter materials carried down in suspension by moving water. The particles are very fine, most of them passing a 60-mesh. The fineness of such soils partly depends on the speed of the moving water; the swifter the flow the coarser the particles.

The particles are arrested and precipitated all along the banks of the river during flood time. During heavy floods very large quantities of matter are often deposited along the banks, but they are often of a coarser nature due to the higher speed.

The particles which go to make up all alluvial soil may have been brought from considerable distances; they constitute the fine part of soils liable to wash within the drainage area of the river. Attempts have been made in some countries to regain this suspended soil by the process called "warping," which is only practicable in the neighborhood of tidal estuaries. This is accomplished by letting the water run over the land, and then cutting it off from the main supply by sluices; after some time by repeatedly going through this process, a soil is built up. This artificial alluvial soil is usually rich in organic matter and other plant food, but usually poor in soluble food such as potash.

An example of an alluvial soil is given below. The sample was taken from the banks of the Mahaweli-ganga at Peradeniya:

Analysis of alluvial soil, experiment station, Peradeniya.

[Mechanical composition.]

	Per cent.
Fine soil passing 90-mesh	53.90
Fine soil passing 60-mesh	43.00
Medium soil passing 30-mesh	3.00
Coarse sand and small stones	0.10
	100.00

The sample is a micaceous loamy deposit in a fine state of division with a fair power of retaining moisture. There is a fairly good supply of organic matter with a good supply of nitrogen. The acidity, as is to be expected, from such a soil is nil. The mineral plant food is good in lime, magnesia, and potash, mainly derived from the mica, but is rather poor in phosphoric acid.

Tea and cacao soils.—On many estates the tea and cacao have been interplanted with rubber, and the variation in soil composition is very great.

The following analyses show the composition of tea and cacao land now planted with rubber, the latter showing a great growth in the Paradeniya district:

Analysis of soil from typical cacao land interplanted with rubber.

[Mechanical composition.]

	Per cent.
Fine soil passing 90-mesh	48.00
Fine soil passing 60-mesh	42.00
Medium soil passing 30-mesh	8.00
Coarse sand and small stones	2.00
	100.00

PLATE III. CLEARING LAND FOR PLANTING IN RUBBER, CEYLON.

Analysis of soil from typical tea land interplanted with rubber.

[Mechanical composition.]

	Per cent.
Fine soil passing 90-mesh	34.00
Fine soil passing 60-mesh	25.00
Medium soil passing 30-mesh	10.00
Coarse sand and small stones	31.00
	100.00

Swamps.—The cultivation of rubber in such areas has during the last year shown a considerable increase. Providing the draining and liming of the soils are efficiently carried out there seems no reason why continued satisfactory growth should not be obtained on such land.

The drainage should be very thorough so as to allow a good percolation of air and water through the otherwise sour soils.

In some cases each rubber tree should have a separate drainage system, the drains being 2 or more feet wide and 3 to 4 feet deep, the material from them being heaped up near the rubber tree. In other cases each line of rubber trees may be separately drained. When the drains are sufficiently large and the soil from them is heaped around the rubber, a dry soil is ultimately obtained, in areas which have hitherto been too swampy for any cultivation except paddy. The following analysis will show the general composition of such a soil:

Analysis of swampy rubber soil from the Southern Province (black soil).

[Mechanical composition.]

	Per cent.
Fine soil passing 90-mesh	36.00
Fine soil passing 60-mesh	36.00
Medium soil passing 30-mesh	1.00
Coarse sand and small stones	4.00
	100.00

The above sample shows a chemical richness in organic matter and nitrogen which rarely obtains in low-country districts and strongly reminds one of the soils at high elevations in Ceylon. It is to be regretted that the area of such rich land in the low country is small, and the above analysis is certainly encouraging to planters who have swampy soils capable of being effectively drained and made sweet by the application of lime or by burning. To a certain extent the method to be adopted with such soils is similar to that for the peaty tracts of the Nuwara Eliya district.

In planting rubber land is usually selected that is covered with virgin forest. The forest trees are felled and allowed to lie on the ground until there is a dry spell, when they are burned off. Stumps are not removed, neither are the tree trunks that do not burn, but they are left on the ground to rot. After the burning, with the exception of the large timber and stumps, the land is perfectly clean and ready for planting.

Some of the planting is done on fields that were formerly used for tapioca and also rice cultivation. After being abandoned by the planters

of these crops the lands become overgrown with "Lalang" grass (*Imperata arundinacea*), one of the most troublesome weeds in Malaya, which grows and spreads like our Hilo grass. Lalang is an oily grass and cattle will not eat it. Fortunately it will not grow in shade and consequently is easily kept out of rubber groves where the trees shade the ground, nor does it grow in the jungle. The average cost of clearing an acre of lalang is about $24 (U. S. gold), which is more than it costs to fell and clear jungle forests.

Planting is done from seed. The seed is oval in shape and about the size of an ohia seed. The bulk of the seed crop ripens in August and September, although the trees seed more or less all through the year. As the seed quickly loses its germinating power it is planted soon after ripening.

The planting of Hevea trees is done in different ways. Unquestionably trees planted "at stake" grow much quicker than trees planted in any other way and if the seeds were plentiful at all seasons of the year there would probably be more planting "at stake." In Ceylon the method that is considered the best is to plant the seeds in woven palm-leaf baskets about 8 inches in height and 4 inches in diameter and when the plants are about a foot high, plant baskets with trees in their permanent positions.[1] This basket method comes nearest to planting at stake and there is minimum uninterruption in the growth of the young plants in setting them out. The more general method, however, in the Far East is to plant seeds in nurseries about six inches apart. Seventy-five to 90 per cent of the seeds planted germinate. The ground selected to be used as a nursery is carefully prepared. It is thoroughly dug up and weeds and roots removed and the soil pulverized by hand. The young plants are left in the nurseries for several months, until they are from 18 inches to 2 or 3 feet in height, when they are stumped, the tap roots cut, and the plants transplanted, removing as little soil from the roots as possible.

Transplanting has to be done when the weather is favorable and after the land has been cleared and burned. As dry weather is necessary for a good burning, the time for transplanting varies and depends on weather conditions. The young trees are planted in rows but the distance between the trees and between the rows varies a great deal on different plantations. There is a difference of opinion on this point, but it is generally considered to be a fact that planting closer than 200 trees per acre is a failure.

A great deal of the planting at the present time is in avenues. In Ceylon most planting now being done is in avenues 20 feet wide, the trees being 15 feet apart. They are planted so that the avenues run east and west. This gives the sun a chance to shine on the soil. In

[1] Bamboo pots may be used—Editor.

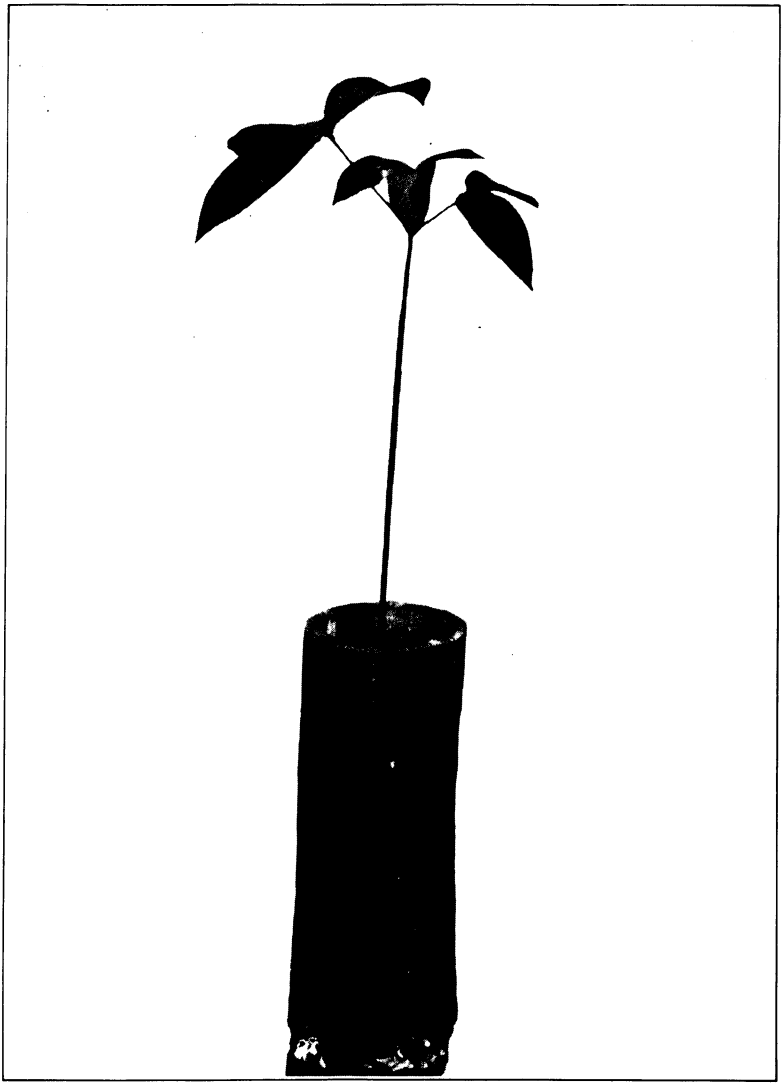

PLATE IV. YOUNG RUBBER TREE IN BAMBOO POT, SINGALONG EXPERIMENT STATION, MANILA.

Malaya most planting is now being done 12 by 24, or 148 to the acre. Some planting is being done 15 by 30, or 96 per acre. One plantation I visited was planting in equilateral triangles, the trees being $17\frac{1}{2}$ feet apart, or 160 per acre, as against planting in rectangles $17\frac{1}{2}$ by $17\frac{1}{2}$, which would give only 140 per acre.

Most plantations weed clean. This is very expensive, and there are some plantations that weed only in rows while others weed still less. I saw on one of the best paying estates, a field of two-year-old trees growing in a lalang patch where they had only weeded the lalang around each tree. These trees were doing very well. On a great many plantations the weeds are easily cleaned out after the burning, and by keeping them down at first the expense of weeding is not great. Such land can not be compared with our land where we have hilo grass to contend with. In Ceylon the older men prefer clean weeding, but green manuring is coming in vogue rapidly.

In places where the land is low and swampy it is drained so that there will be no standing water around the trees. Where the trees are planted on the hillsides drains are dug at intervals to prevent the water from carrying away the top soil.

There is no cultivation as a rule beyond hoeing the weeds as the soil does not pack and consequently does not need to be loosened. * * *

Hevea grows in two forms, one more bushy than the other. Planters in Ceylon and Malaya prefer a tree fairly branched. There is a great deal of thumb-nail pruning to make the trees branch at the height desired. This also has a tendency to make the tree large at the base. If a tree branches at 10 or 15 feet from the ground it is about right. Planters who have "topped" their trees state that it results in two large branches forming, which is apt to split the trunk where the two branches meet if the wind is strong. The more leaf area a tree has the better and the quicker will the bark "respond." * * * The question of how close or how far apart the trees should be planted is one that has had a great deal of attention and is of vital importance.

In considering the problem of how many trees it is best to plant to the acre, it is necessary to consider conditions as they are likely to exist in the future. In planting rubber for profit, it is the percentage of profit on the capital invested which determines its value as an investment rather than the gross earnings or profit per tree or per acre, or the total output of the plantation.

If we let

A. Represent acreage planted.
X. Represent number of trees per acre.
T. Represent number of times a tree is tapped per year.
C. Represent capital invested.
n. Represent number of trees per day one man can tap.

y. Represent yield per tree per day's cutting.

p. Represent price per pound of rubber.

L. Represent day wage per laborer.

E. Represent expenses other than for labor.

Then the market value of the rubber collected from one tree at a single tapping, less the cost of collecting same in laborers' time, multiplied by the total number of tappings per year on all the trees, less general expenses other than for labor, will be the total profit for the year. Dividing this by the capital invested will give the percentage of profit on the investment, or

$$\text{Percentage of profit on capital invested} = \frac{AXT\,(py - \frac{L}{n}) - E.}{C}$$

In this equation the value of X varies directly as C and inversely as y. The more trees planted to the acre or the larger X is the smaller the yield y will be and also the larger the capital to be invested, C. Then again the more py exceeds $\frac{L}{n}$ the greater will be the profit. Experience must determine what effect increasing n has upon the value of p and y; hence to arrive at the number of trees per acre that it is best to plant in order to obtain a maximum percentage of profit on the capital invested we must consider:

C. Capital invested.

L. Cost of labor when trees come into bearing and also what it will be in the next ten or twenty years.

p. Market price of rubber in five, ten, and more years.

y. Yield per tree at each single tapping.

T. Number of times per year it is best to tap each tree to get the best results.

n. Number of trees per day one man will be able to tap.

Some planters think it will be more profitable to plant for a period of ten or fifteen years only while others have confidence in the future beyond that time.

If trees are planted too close together they grow tall and have small leaf area and under these conditions the bark does not grow as quickly as on trees planted wider apart. Neither does the new bark form and grow over the tapped surface as quickly as in wider planting and it is now found necessary to rest a too closely planted forest, while continuous tappings can be made on wider plantings. The trees are usually considered large enough to be tapped when they are 20 inches in circumference 3 feet from the ground, but one grove that I saw which was planted 10 by 10, or 436 to the acre, although large enough in circumference when five years old, the bark was found to be too thin to tap. On another plantation they were tapping two groves of the same age,

Plate V. LINING, HOLING, AND PLANTING PARA RUBBER, CEYLON.

eight and one-half years, one planted 12 by 24, or 148 per acre, and the other 12 by 12, or 296 per acre. The 12 by 24 trees gave an average yield of 3 pounds per tree, while the 12 by 12 trees average a little less than 1¾ pounds and gave less on second tapping, thus acre for acre the yield was about the same. The yield of rubber from each tree for one day's tapping was almost double from the trees in the 12 by 24 planting as compared with the 12 by 12 planting, and as each coolie makes 80 tappings per day in either grove the cost of collecting a pound of rubber is nearly double in the grove more thickly planted.

I visited a grove planted eleven years ago 24 by 24, or 74 per acre. In talking with the gentleman who planted these trees he stated that if he were planting for himself he would plant at least 24 by 24 (74 per acre), and perhaps 30 by 30 (46 per acre). That he would do this with the idea of making good profit twenty years from now as well as in the earlier years. Eight hundred trees in a planting of eleven-year-old trees, 60 to the acre, averaged a yield for the year of 7 pounds, or 420 pounds of rubber per acre.

Trees in Malaya usually attain a circumference of 20 inches 3 feet from the ground in from four to five years. In Ceylon a few trees will reach this size in five to six years, and many in six to seven years, when they are tapped at the base.

Hevea is usually tapped every second or third day with rests every dry season. Some estates tap as above for 15 tappings and then rest the trees from three to five months. For instance, they will tap an area one day and another the next day. If the trees are planted wide enough apart this can be kept up indefinitely, tapping each tree from 30 to 45 times a year. Tapping is usually done in the morning before the heat of the day. Some of the larger plantations tap all day or until 2 o'clock. The flow is better in the early morning. To tap, a farrier's knife, a carpenter's gouge, or some special tapping tool is used to cut the bark. A lateral cut in the bark is made, care being taken not to cut through the cambium; it is made in such a way that the latex runs down in a groove until it reaches a tin or aluminum cup which is placed at the foot of the tree.

There are a number of ways in which the cuts are made, the simplest being a "V."

The system shown in Plate No. VII is called the herringbone system. There are a number of modifications of this system such as the half-herringbone system, in which the lateral cuts are all made to run into a vertical cut. Sometimes the slanting cuts will go halfway round the tree, one side of the tree being tapped this way until all the bark has been cut and then the other half is tapped, the lateral cuts running into the vertical cut on the opposite side of the tree. Sometimes both sides of the tree will be tapped by this system at the same time, a cup

being placed on either side of the tree under the vertical cut. Again two sides of the tree will be tapped at the same time on the half-herringbone system with the lateral cuts only extending a quarter of the way round the tree, so that the two sections on opposite sides of the tree will be tapped at the same time, while the intervening sections will not be tapped until all the bark has been cut on the first sections. The space between the cuts is measured and a light cut made just deep enough to show the tapping coolie where to tap. Each time a tree is tapped a little mark is made on it so that there is a record kept as to how many times a tree has been tapped.

In one grove, where the average yield is 3 pounds per tree, the half-herringbone system of tapping was being used on both sides of the tree, the laterals going a quarter of the way round only. Each tree was tapped every other day for 15 tappings, and then the trees were rested for three months, so that during the year 45 cuts were made on each side of the tree.

A day's work for the tapping coolie was to tap 40 trees on both sides, thus setting out 80 cups to catch the latex. The coolie's work was not completed until he had picked up the thin strips of bark which were cut in tapping, bringing them, together with 80 cups of latex, to the drying room. He then, after pouring the latex into a large container, must rinse the cups with water, saving the diluted latex thus obtained so that it will not be lost. He then washes the cups which completes his day's work. Women and children tap as well as men. The aluminum cups each hold about a half pint. A little water is put in each cup when it is set out so as to dilute the latex and prevent it from coagulating before it can be brought to the drying room. The amount of latex in each cup of course varies with the yield of the tree. Some trees filling the cups full. The bark shavings that are brought in are put through the scrap machine which consists of rollers which grind the bark into a fine powder. The larger portion of the bark is separated from the scrap rubber after it comes out of the rollers, and then the rubber, and whatever bark has not been separated, is put through a second set of rollers, on which streams of water are playing. This washes the remaining bark from the scrap and the rubber is turned back into the rollers over and over again until it is in the form of crépe rubber. It is then hung up to dry with the other rubber. The latex when it is brought in is strained and set out in pans as milk is set to cream and in three or four days the rubber coagulates in blocks about the size of half a kerosene oil tin.

On several plantations they were using kerosene oil tins cut in half so that the two opposite sides of the tin would be the bottoms of the coagulating pans. Most plantations mix a little acid with the latex before it is set out in the coagulating pans to aid coagulation. The block of coagulated rubber is sometimes rolled into sheets and sold as sheet

rubber, but oftener it is put through rollers under pressure on which streams of water are playing until it is ground into the form of crêpe rubber. On one or two plantations the crêpe or sheet rubber is compressed into blocks. The drying room or house is very often made of corrugated iron, or at least the roof is corrugated iron, and the rubber is hung up to dry. Some plantations use a vacuum dryer for drying the rubber.

As there are so many methods of tapping employed on the different plantations, it is hard to say which system will eventually be perfected. I found, however, that where the single "V" system was used the amount of rubber collected per day for each coolie tapping and collecting was almost double that of plantations where they were using other systems in which five times as much bark was cut per tree.

Coolies get about 37 rupee cents per day in Ceylon or 12 cents, United States gold. In Malaya about 30 to 35 cents, Straits currency, or 18 to 20 cents, United States gold, and they work about twenty-four days, of eight to ten hours each, per month. Most of the coolies are Tamils, Javanese coming next in number, while the native Malays are employed principally in felling and clearing forests and in digging drains by contract. In Ceylon out of 450,000 laborers employed in different industries, 400,000 come from India. The Tamil coolies do not expend very much on clothing, and a great many of them manage to save money to remit to India. They are not a muscular people, having very slender arms and legs, but they can carry a greater weight on their heads than they are capable of lifting. In tapping rubber trees, the Tamils are very good as they are very quick, and it is not hard work. The Javanese are good workers and also good at tapping. The women work in the fields as well as the men, but do not get as large wages.

The output of a rubber plantation depends on the average age of the trees tapped. As the trees grow older the output will increase, but to what extent remains to be proved by experience. The output of one plantation in 1906 of 134,285 pounds, increased in 1907 to 193,506 pounds, from 84,278 trees tapped during the year or an average of over 2 pounds per tree.

Their largest trees were eleven years old, but two-thirds of them were under six years old.

This plantation was using the half-herringbone system of tapping, the laterals going half way round the tree to the vertical cut on one side while the vertical cut on the opposite side drains the lateral cuts from the other side of the tree. On the new trees that are coming into bearing they are using the single "V." A tapping is made every other day on some of the trees and every third day on others for a period of six weeks when the trees are rested for six months. There is an average of one tapping coolie to 3 acres and a carpenter's gouge is used for a tapping tool.

CEARA RUBBER.

Most of the remarks in reference to Hevea apply also to Ceara, with some important exceptions.

Twenty-three years ago Ceara was planted as shade for tea plants, but on account of inexperience in tapping and as the Ceara trees were not satisfactory as shade they were, unfortunately, nearly all cut out. Ceara rubber trees can be planted and will grow well at higher elevations than Hevea. Most of the Ceara trees I examined were growing at an altitude of from 500 to 3,000 feet above sea level. Ceara can be planted where the temperature goes as low as 45°, but a temperature above 50° is preferred. As to rainfall, Ceara does best where there is 50 to 120 inches of rain per annum. The best Ceara I saw was in a district where the rainfall is only 60 inches per annum. The trees will grow in rainier districts, however, but tapping is not so successful as in drier districts. The rainfall at the garden is 180 inches per annum. The Ceara trees shown in the picture are eight years old and though they grow tall, the largest is only 24 inches in circumference 3 feet from the ground, while the others are much smaller.

On arriving in Ceylon, I found that there was only one estate on which there were Ceara trees being tapped to any extent and the output on this estate amounted to only 4,000 pounds of rubber per year.

The main planting on the estate was cacao, coconut and Ceara rubber trees being planted for shade. No new Ceara rubber trees are being planted, but from the young trees that spring up the best only are allowed to grow while the poorer ones are cut out. As a rule these trees are 20 inches in circumference 3 feet from the ground when they are three years old and are then old enough to be tapped profitably. The manager thinks that the yield is greater when the trees shed their leaves. The growth of these young trees varies a great deal and trees that get a start when the weather is showery in the morning and sunny in the afternoon grow quicker than those which sprout when the weather is too rainy and is cold at night. An ordinary curved pruning knife is used in tapping on this plantation. The bark is cut through the cambium to the wood, removing a piece of bark an eighth of an inch wide. "V" cuts are made one above the other a span apart, but no vertical cut is made, the latex being allowed to flow over the bark. The manager claims that they get less scrap rubber in this way. The tree is tapped until an inch of wood is exposed. The other side of the tree is tapped in the same way and then the tree left until the bark grows over. There is not the "wound response" in the Ceara that there is in the bark of the Hevea tree so that in tapping by this method an eighth of an inch of bark is removed each time the wound is reopened in order to get a good flow. With the Hevea it is only necessary to reopen the wound and the thinner the shaving the better. On account of the "wound response"

PLATE VI. SOWING SEED IN PARA RUBBER NURSERY, CEYLON.

the flow of latex increases as the tappings proceed up to a certain point. This is not the case with the Ceara which is more apt to be the other way.

When the bark rots and comes off the shot-hole borer attacks the tree, weakening it, and it is likely to blow over when there is a strong wind. Experience has shown that in the more rainy districts of Ceylon tapping has been unsuccessful, killing a great many of the trees.

The bark of the Ceara rubber tree is thinner than the Hevea and has a tendency to tear if the tapping knife is not sharp. This makes it harder to tap the Ceara when the same methods of tapping are used. It is considered more satisfactory on this plantation to tap as they do rather than use more careful methods as the young trees grow up so quickly that as soon as one tree dies there is another ready to be tapped in its place. A coolie taps the trees, sets out the cups and brings in the latex, setting it out in the pans to coagulate and rolls it into biscuits the next day. This constitutes a day's work for a coolie, if he brings in enough latex to make half a pound of dry rubber.

The rubber biscuit, after being rolled and washed, is spread on coconut leaves in the dry room and usually takes about three weeks to dry. As a coolie is paid the equivalent of 12 cents gold per day, it will be seen that the labor of collecting and making the biscuits costs 24 cents per pound. The latex on this plantation is coagulated by being mixed with water. Water coagulates Ceara latex very quickly. This fact makes it more desirable and more profitable to tap Ceara trees in dry weather as the rain coagulates the latex on the tree, making a bigger percentage of scrap. Ceara latex differs in this respect from the latex of the Hevea tree. Where water is used to delay coagulation of the latex from the Hevea tree, it has the effect of hastening coagulation with Ceara latex. This makes it more difficult to handle the Ceara latex than Hevea.

On some of the tea plantations that I visited where they have a few Ceara trees remaining they are more careful in tapping and use the herringbone method, cutting only a little way into the bark and using a pricker.

The trees are scattered and a day's work for a tapping coolie on these plantations is a third of a pound per day of dry rubber. Here the rainfall is large and more care has to be taken in tapping to preserve the tree.

I visited one plantation where they had a grove of 250 Ceara trees. This was at an elevation of 3,000 feet and where the annual rainfall was from 120 to 150 inches. This is the highest elevation at which I saw rubber growing. Twenty-three years ago on this plantation Ceara rubber was planted as shade for the tea, but later it was all cut out with the exception of a belt of 450 trees. These trees in the last few years have been tapped, but since tapping commenced 250 of them have died as a

result of tapping. It is considered unsafe at the present time to take more than 250 pounds of dry rubber per year from these 200 trees. Three coolies work on the trees from September to the end of March. The largest tree is 49 inches in circumference 3 feet from the ground, and the tapping system is a series of "V's" draining into a vertical cut.

A weak solution of ammonia (2 to 5 per cent) is used to prevent coagulation caused by water in the collecting cups, or from coagulation by churning while being carried from the trees to the coagulating rooms.

This plantation gets 4s. and 2d. a pound for their Ceara when Islands Fine (wild) Para brings 3s. and 4d., but 10 pounds of the latter equals 8 pounds of cultivated on account of its having a smaller percentage of moisture, so that the prices are really equal. It gets a little better price than plantation Para.

At present they are tapping over renewed bark without finding it necessary to remove any outer bark. The manager here thinks that if the same methods of tapping were used and the trees tapped first when young, it would not be necessary to remove the outer bark as it would not have time to get too thick. They tap the trees every third day for seven months, except in rainy weather, cutting a shaving a sixteenth to an eighth of an inch in thickness. The cut is shallow, not reaching the cambium, but a pricker is used to augment the flow. As the trees were old the outer bark removed was quite thick.

In conclusion I beg to submit the following general facts, conclusions, and opinions concerning the rubber industry which I gathered during, and in connection with my trip, which I hope may be of value to those interested in rubber production in Hawaii:

The present rubber production of the world is approximately 70,000 tons per annum.

The greatest source of rubber is the forests of Brazil which produced 41,000 tons in 1907.

The cultivation of rubber is now going on in nearly all the tropical countries of the world, being followed most largely in Mexico, Central America, India, the Malay Peninsula, Ceylon, and Java.

It is difficult to ascertain the exact area under cultivation, which is large, but the adaptability of different localities to rubber production has yet to be determined. It is certain that a very large proportion of the areas planted are unfitted for rubber cultivation or the wrong varieties of rubber trees have been planted. There is little danger of the rubber market being overstocked for some years to come from either wild or cultivated sources.

Although a large area has been planted with rubber the production of the cultivated article has just begun, as is evidenced by the fact that the output of this product from Ceylon and Malaya for 1907 was only approximately 1,178 English tons.

The unknown quantity in Hawaii is the labor question. Tapping requires in Ceylon and Malaya a man for every 1 to 4 acres, according to the number of trees planted per acre and the convenience of the location. The price of labor will also be a vital feature. In Ceylon and Malaya the laborer receives from 12 to 30 cents gold per day, while in Hawaii we are obliged to pay 75 cents to $1 per day.

As to the relative efficiency of labor in the Far East and in Hawaii, I am of the opinion that for the work of collecting rubber, our labor is as efficient and will accomplish more, as under local conditions 20 to 25 per cent more time will constitute a day's work.

The Ceara tree will grow much quicker than the Hevea tree, but, on the other hand, Hevea will yield more abundantly and the cost of collecting the latex will be less. Comparatively little attention has been given to the methods of collecting rubber from the Ceara variety of rubber tree as there are but a few dollars invested to thousands of dollars invested in Hevea planting. Tapping experiments should be made as soon as possible on our Ceara plantings in order that more may be known before our trees come into bearing. There is still much to be learned through the experience of others in various rubber producing sections of the world, but, after all, we must very largely work out our own methods and learn for ourselves how best to meet our own problems, although the experience of others will always be of benefit.

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SYSTEMS OF TAPPING CEARA RUBBER TREES.[1]

By Jared G. Smith,

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AND

Q. Q. Bradford,

Assistant in Rubber Investigations.

A striking characteristic of the Ceara rubber tree is that it sheds its bark at frequent intervals. The outer bark is tough and papery. As a new growth of bark forms immediately outside of the cambium layer, the outer bark dries and sloughs off. This process is continuous.

Before beginning tapping the entire outer bark should be removed from the trunk without injuring the living inner bark. This is easily done with a curved-blade knife shaped like a pruning hook, making one vertical cut and peeling off the bark in rings.

There are four systems generally employed in tapping the Ceara and other rubber trees in rubber-producing countries. These are the half herringbone, the full herringbone, the spiral, and the vertical cut systems. The half herringbone consists of a single vertical cut with laterals about a foot apart at an oblique angle extending half around the tree. The full herringbone consists of a vertical cut with oblique laterals on both sides extending entirely around the trunk of the tree. The spiral is a single or double oblique cut extending from the bottom to the top of the tapping area without vertical channels. In the vertical system there are from one to half a dozen vertical cuts without oblique laterals.

The Ceara rubber tree differs from both the Castilloa and Hevea in the rapidity of the coagulation of the latex. For this reason it has been found that the system of vertical cuts is the best. The station has carried on a large number of experiments in the methods of tapping. It has been found that the average Ceara rubber tree stops its flow of latex by complete coagulation within from two to five minutes when the latex is permitted to flow in the wound without the use of water. By trickling water over the wound the period of flow may be extended to

[1] Extract from "The Ceara Rubber Tree in Hawaii," Bulletin No. 16 of the Hawaii Agricultural Experiment Station.

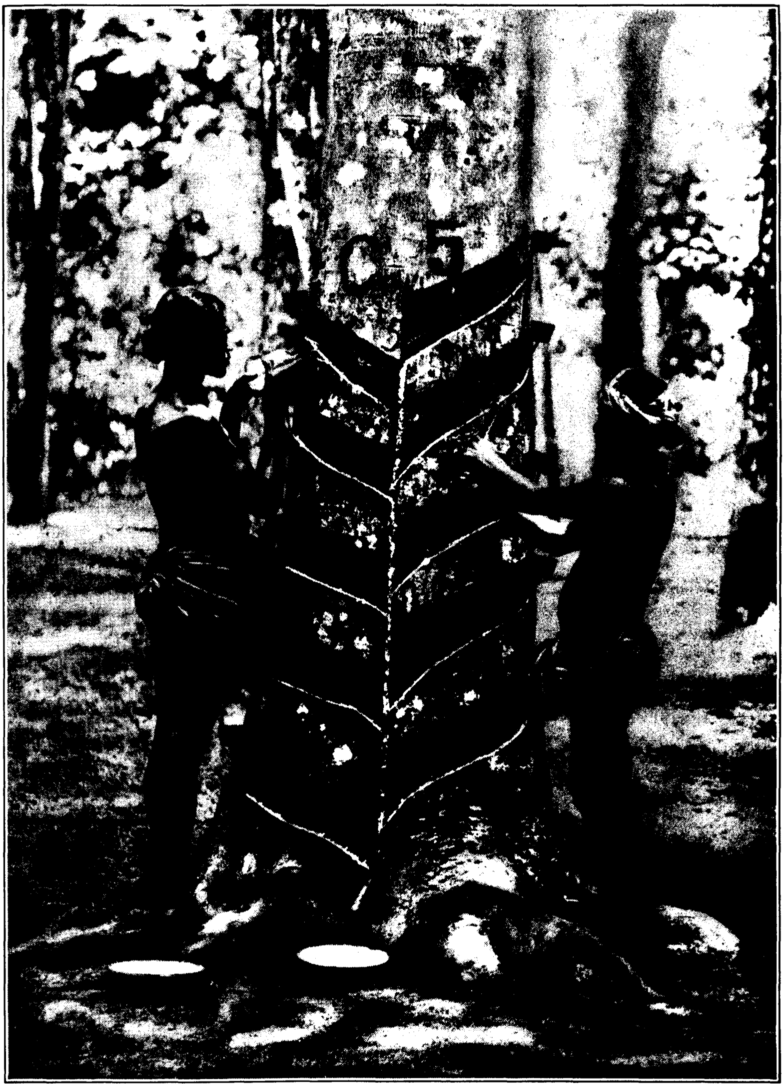

PLATE VII. FULL HERRINGBONE SYSTEM OF TAPPING PARA RUBBER; DRIP TINS ATTACHED TO TREE AT TOP OF CUTS; COLLECTING TINS ON GROUND.

several minutes, but if the water is rendered alkaline with ammonia the period is extended sometimes from thirty to forty minutes.

It has also been quite definitely determined that a system of single or double vertical cuts, from 3 to 6 inches apart, without any oblique laterals except at the base, for the purpose of concentration of all the latex at one point, gives the heaviest yield of rubber and the least waste. A vertical cut is much more easily made than either the spiral, half herringbone or full herringbone oblique cuts. Another point in favor of the vertical cut is that the wound thus formed heals with the greatest rapidity.

The first cut should be extremely shallow. The cut should be flat, with sharp sides one-eighth of an inch wide, and, if practicable, not more than one thirty-second of an inch in depth—the thinnest possible shaving. It is especially important in young trees not to cut too deeply, because the bark is very thin, and there is great danger of permanently injuring the tree by cutting through to the cambium. The second tapping should be in the same cut without widening it. The next cut and the cuts of each succeeding day, as long as the tapping period lasts, should be to simply freshen the wound at one side only of the vertical incision. In this way the tapped area will be extended gradually in one direction around the trunk and will be followed by rapid healing of the wound from the opposite margin of the cut. The number of vertical cuts will depend on the diameter of the trunk. They should be not less than 4 or 5 inches apart, because the daily tappings drain the latex from the bark for from 1 to 2 inches in every direction from the wound. Enough uninjured bark must be left between the wounds to admit of rapid recovery and not too seriously interfere with the vital processes of growth.

TIME TO TAP.

The best time to tap Ceara rubber trees is at night or during the early morning. If tapping is done during the day it should be on the shady side of the tree. The reason for this is because of the tension of sap and latex in the body of the tree. Evaporation of water from the leaves is most rapid during the daytime. The greatest activity in pumping up water from the soil is also in the day. Under the action of direct sunlight the leaves accumulate great quantities of starch and sugars. At night there is a transfer of carbohydrates in soluble form from the leaves to those parts of the tree where growth and the formation of new tissues are taking place. During the hours of darkness there is almost complete cessation of evaporation from the leaves, but the roots continue to take up water from the soil. This results in tension and explains the reason why the flow of latex is much heavier and more rapid during the night. Coagulation is also retarded by the lower temperatures at night.

The best time to tap seems to be between 12 o'clock midnight and 7

o'clock in the morning. It is believed that some adaptation of the miner's lamp to be worn on the hats of the workmen will be necessary. If the tapping operation is postponed until earliest dawn it would largely increase the number of men required, owing to the few hours during which profitable tapping can be carried on.

The best season of the year for tapping has not been determined, but the indications are that it would be during the rainy season. In Hawaii the Ceara rubber trees can be tapped at any time of the year, but this operation should not be carried on during the resting period when the tree is bare.

APPARATUS AND METHOD OF TAPPING.

As a result of many trials, it was found that a cloth or canvas water bag was of great advantage in collecting the rubber. A water bag large enough to hold about a quart of water, made with alternating narrow strips of thin porous cloth and oiled cloth or canvas, is tied around the tree 6 or 7 feet above the ground, just above the tapping area. These bags are of cheap construction and will last for many months if properly cared for. A water bag should be fastened to each tree before the tapping begins and should be left on the tree during the whole tapping season.

At the base of the tree the water and latex are collected in zinc, galvanized-iron, copper, aluminum, or enameled cups, or in wooden or earthen vessels. Iron vessels should not be used because of the corrosive action of the ammonia recommended for use in tapping. The water and latex are collected at one point at the base of the trunk by inserting a thin sheet of zinc obliquely beneath the outer bark. The channel and spout thus formed are not to be fastened into the body of the tree because of injury to the wood. This tin or zinc collar and spout should be left on the tree during the whole tapping season.

The knife should cut a shallow, flat channel with vertical margins and should be capable of delicate adjustment, because the bark of the Ceara rubber tree is very thin.

The preliminaries having been attended to, a water carrier goes through the grove, filling each of the bags with a pint of water containing ammonia at the rate of one-half ounce per gallon of water. The rubber contained in the latex of young trees coagulates more slowly than that in the latex from old trees, so that in tapping a young grove a minimum amount of ammonia will be required. The water carrier should remove all scrap rubber from the tree, so that the wound will be clean and fresh for the tapper.

Immediately following the water carrier comes the tapper, who rapidly freshens the wound or cuts a new channel, as indicated above, and passes on to the next tree. As soon as all the water has dripped out of the bags,

PLATE VIII. OPENING LATEX TUBES IN AREA OF WOUND, PARA RUBBER, CEYLON.

collectors follow the tapping gang, empty the containers into barrels or other receptacles for transportation to the coagulating house or central mill.

COAGULATION OF THE LATEX.

The first operation in coagulation is to strain the latex to remove particles of bark or earth or other large impurities.

A number of methods of coagulating latex are in use in rubber-producing countries. Among these are acetic acid, sulphuric acid, trichloracetic acid, common salt, alum, heat, evaporation, churning or agitation, and centrifugal force.

In the experiments which we have undertaken, as stated above, ammonia is added to the water which flows over the wound in the bark of the tree, made for the purpose of extracting the latex from the tree. The action of ammonia seems to retard coagulation. Latex containing moderate quantities of ammonia will remain without any appreciable coagulation for considerable periods, provided the mixture of water and latex is not violently churned, stirred, or shaken. In order to get rid of the ammonia, dilute sulphuric acid is added until the mixture shows a neutral reaction with litmus paper. The addition of sulphuric acid to a point of neutralization results in the formation of a small quantity of ammonium sulphate in the liquid. After standing about one hour, a boiling concentrated solution of ammonium sulphate is poured into the neutralized latex and the whole is gently heated or left standing. As the mixture is heated the rubber separates from the latex and water mixture and rises to the surface. The temperature of the liquid should not be permitted to go above 170° F., as the elasticity of the rubber is affected by high temperatures. The same result—that is, complete separation of the rubber from the water and latex mixture—can be obtained by allowing the latex to stand for a period of two to six hours after adding the ammonium sulphate solution, without heating, but the saving of time warrants the use of heat.

The rubber can also be coagulated by adding acetic acid without the use of heat. After adding the acid the mixture should be churned or stirred.

A very pure quality of rubber can be produced by the use of ammonium sulphate, because this salt precipitates the proteids, the proteids being compounds very liable to rapid decomposition. However, from the manufacturer's standpoint, it seems to be immaterial whether the rubber is free from proteids and other impurities.

Sulphuric acid is also a coagulant, but it should only be used in very dilute solutions.

Formalin may be used in conjunction with either ammonium sulphate, acetic acid, or sulphuric acid. When present in large excess, especially

in the presence of ammonium sulphate, it has a rapid coagulating action. While the rubber produced by its use is of very high quality, the formalin preventing decomposition of the finished product, this compound is as yet too expensive for general plantation use.

Rubber may be obtained from the water and latex mixture without the use of ammonium sulphate by churning, by adding either acetic or sulphuric acid, with or without heat, or by simply allowing the liquid to stand until putrefaction begins.

One of the advantages of the collection of latex by means of water trickled over the wounds is the possibility of producing a product entirely free from bark, earth, twigs, and other gross impurities and adulterants. Where rubber has been collected from wild trees the common method has been to simply slash the trunk and branches, permitting the latex to flow down them or fall upon leaves placed upon the ground beneath the tree. This method is a very wasteful one, and the rubber thus obtained is of uniformly low value because of the amount of dirt and other impurities. This method is not at all adapted to modern plantation conditions.

Every effort should be made to produce rubber of the purest and best quality; and it is believed that such rubber can best be produced from the Ceara tree by the use of considerably quantities of water in all of the processes connected with the collection and coagulation of the latex.

A METHOD OF GERMINATING CEARA RUBBER SEEDS.

A new and rapid method of germinating Ceara rubber seeds, perfected at La Zucualpa Botanical Station (Mexico), is described by Dr. Pehr Olsson-Seffer as follows:

Place a layer of fresh horse manure in a box, to the thickness of about 6 inches, spread the seeds on the surface and cover with about 1 inch of the same material mixed with a small quantity of sand. The soil should be slightly packed and the box covered with glass. If put in a warm place or in the sun, germination will take place very quickly. The seedlings should be planted as soon as they are an inch or two high and some manure added to the soil. After such treatment the seedlings will grow very rapidly. In planting at stakes the holes should be made as large as possible, or at least 4 feet square. The soil should be well weathered and if too sour, some lime should be added before planting.

PLATE IX. TAPPING A RUBBER TREE, CEYLON.

AGRICULTURE IN BORNEO AND THE FEDERATED MALAY STATES.

By F. W. FOXWORTHY, Ph. D., *Bureau of Science (Botanist)*.

BORNEO.

Borneo,[1] although much more than twice the size of the Philippines, has a population only about one-fourth as great. This population is scattered and has not done very much toward the development of agriculture in the island. There is no very general system of cultivation. The people in most places are in a very backward state of civilization and do not raise enough food-stuffs for their own use. Very many of the natives raise less than enough rice for their own use and must get the rest of their food by hunting and fishing or by gathering rattan and other jungle products, which they sell to traders.

The three principal divisions of Borneo are Sarawak, containing approximately 50,000 square miles (about one and one-fourth times as large as the Island of Luzon); British North Borneo, comprising perhaps 34,000 square miles (about the same size as the Island of Mindanao); and Dutch Borneo, with an area of about 205,000 square miles. These may be considered in their order of agricultural development.

SARAWAK.

The principal crops are rice, sago, pepper, gambier, coconuts, rubber, and pineapples.

Rice.—Here as in all other parts of Borneo there is but little irrigated or lowland rice. The dry or upland varieties are very generally grown. In the planting of this upland rice a very wasteful practice is followed. The habit is to clear a piece of jungle each year. After one crop of paddy the clearing is deserted and is not used again for at least seven years. By this wasteful method, considerable areas of virgin jungle are destroyed each year. The rice is usually hulled by hand. There is only one steam rice mill in the country. This mill is in the Rajang district and belongs to the American mission. I believe that it is the only steam rice mill in Borneo. Saigon rice is imported to make up the deficiency in the supply each year.

[1] Borneo, area 289,000 square miles, population about 2,000,000; Philippines, area 119,000 square miles, population about 8,000,000.

Sago (*Metroxylon rumphii* Mart.).—Sago flour, the cleaned pith of the sago palm (*Metroxylon rumphii* Mart.) is the principal article of export. The palm grows on moist or swampy ground near the houses. This situation is desirable because wild pigs will destroy the palm if it is left unprotected in the jungle.

After planting the palm very little care is given. It is propagated principally by suckers, though it will grow from seed. The preparation of sago flour is a very simple matter, consisting only of repeated washings to remove the foreign matter. Only the crudest of the washing is done by the natives who cut the palm. The pulp is so full of impurities that it has a dirty brownish color and is taken to the factory where it is repeatedly washed until it is clean and white, and when it is dry put into sacks and shipped. All the work at the factory is done by Chinese coolies. The sago flour of Sarawak is usually of very fine quality and commands a higher price than is paid for this product from other regions. The natives of Sarawak do not ordinarily eat much sago, though it is usually the chief reliance in times of famine when there is a shortage of rice.

The domestic animals are very fond of the palm and eat it in large quantities. In places where chickens are raised for export it is customary to place a section of sago palm trunk across the top of the coop to supply the chickens with food while they are going to market.

The most common form in which the product of the sago palm is seen on the tables of the Europeans of the country is the dessert known as "three-palm pudding." Pearl sago is used as the basis for the dessert and over it is poured first the expressed milk of the coconut and then "gula malacca," the very sweet dark-colored sirup obtained from the sugar palm (*Arenga saccharifera* Lab.). This makes a most pleasing and palatable dish. Where the sirup from the sugar palm is not available a very good substitute may be made by taking the sirup from the sugar of the nipa palm.

Pepper (*Piper nigrum* L.).—Pepper gardens are a very prominent feature of the agriculture of the country. The prevailing low price of pepper within the past year has caused some hundreds of pepper gardeners to leave their holdings, but there are still many hundreds of Chinese engaged in the cultivation of pepper in Sarawak.

The marked regularity of arrangement and the clean cultivation of these gardens is a pleasing and rather novel sight in a country where such things are not the rule. The cultivation of pepper in Sarawak has been described in a very interesting manner by Mr. John Hewitt in the Agricultural Bulletin of the Straits Settlements and Federated Malay States (June, 1908). A very marked thing in the cultivation of this crop is the use of burnt earth as fertilizer. The improvement after the application of burnt earth is very quick and very marked.

To one who is unacquainted with the cultivation of pepper it is a

distinct surprise to find that the black and the white pepper of commerce are both obtained from the same vine. The black pepper is the whole berry and the white pepper is the berry with the hull removed by maceration, drying, and friction.

Gambier (*Uncaria Gambier* Roxb.).—This is a rather straggling shrub and is grown quite extensively in hillside gardens. This industry, like pepper, is suffering severely from the prevailing business depression and many gardens in Sarawak have been deserted during the past year. The cultivation of gambier is considered a degrading occupation and only the lowest class of Chinese coolies (those who have no social position to lose) are engaged in it as a rule.

When the plant is fairly well grown the side twigs on the long shoots are gathered, the young twigs and leaves for a short distance back from the end of the shoot are left in order that the plant may continue its growth without undue delay. These side shoots are gathered at occasional intervals and placed in large wooden or iron receptacles for boiling. There are repeated boilings. The remains of the leaves and twigs are taken out and the remaining liquor is boiled and stirred until it is ready to harden into cakes. It is made into small cakes about 2 or 3 inches square and about 5 or 6 inches long. These are readily deliquescent and if rubbed, will easily liquefy. The coolies very often place impurities in the cakes for the sake of increasing the bulk.

Most of the gambier is sent to India and China to be used as medicine, food, or tanning extract; but some of it is sent to England where it is mixed with the cutch obtained from mangrove bark and used in the tanning of leather. The gambier is said to impart to the leather a degree of softness not to be secured by the use of any other substance.

Para rubber.—The Borneo Company, Limited, has two rubber plantations in Sarawak. The older one of these is at Poac and comprises about 500 acres. Some of the trees are over three and one-half years of age. They are on steep and rather sandy hillsides, but they are doing fairly well with clean cultivation. At Sungei Tengah the same company has a large plantation of some 2,000 acres. This is the best conducted young plantation that I have seen. The land is just freshly cleared and the young plants are making very rapid growth. In a portion of this plantation clean weeding is being done. In other places, legumes (*Desmodium sp.* and *Clitoria cajanaefolia* Benth.) are being used as a cover crop and some cassava is being planted as a temporary crop to keep down weeds. Aside from these two there are no large plantations in Sarawak. The government has a small plantation. A number of the Malay chiefs also have small plantations, but they are given very little care.

Gutta-percha.—On the plantation of the Borneo Company, Limited, at Poac, some hundreds of young gutta-percha trees have been planted along the roadways and in the jungle and are doing very well. Some

of these trees are about four years of age. It is the only place in Borneo where I have seen gutta-percha in cultivation.

Coconuts.—There are numerous small plantations which are not well cared for. In many places the trees are badly infested with the rhinoceros beetle. Unfortunately no steps are being taken to combat it and the pest continues to grow worse. There are two crude manufacturies of coconut oil in the country, which produce a second-grade oil for local use.

Pineapples.—There is cultivated in Sarawak a very much improved Kew pineapple which has a flavor surpassing that of any other pineapple I have ever seen. These pineapples are very large—often 16 to 18 inches in length and as much as 8 inches in thickness. Unfortunately the fine texture and large quantity of juice in this fruit render it unsuitable for shipment.

The durian and the mangosteen reach probably their highest development in Borneo. The mango is but little cultivated and of poor quality.

Cattle.—At the different outstations, there are kept small herds of Indian cattle in order that the outstation officers may be supplied with fresh milk. These herds are usually cared for by Kling coolies and seem to keep in very good condition. The principal beast of burden is, of course, the carabao or kerbao, as he is called by the Malays.

In northern Sarawak there is a very small breed of carabaos, adult specimens appearing not more than two-thirds the size of the ordinary carabao of the Philippines.

BRITISH NORTH BORNEO.

The one specially noteworthy crop of British North Borneo is tobacco. Lahad Datu, on Darvel Bay, is the headquarters of the syndicate. The tobacco lands run back for 8 or 10 miles from the coast and are said to constitute the largest single tobacco plantation in the world. Cultivation is at a very advanced stage and the tobacco produced is a very high grade of wrapper, commanding a very good price in the European market. The company is English, but a number of the men have received their training on the plantations about Deli, Sumatra. The soil of the Lahad Datu plantations seems much like some that we have in the Philippines. The climate is rather moist. There is no very pronounced dry season.

There are several rubber plantations which have been running for a number of years but they do not seem to have been conspicuously successful. Plantations of rubber are still being put in. Judging from the rate of growth of the young plants, these plantations should prove successful under proper management.

Coconuts are cultivated to some extent, but there are only a few very primitive presses.

PLATE X. LATEX IN SETTING OR COAGULATING TINS; TRANSPORT PAILS USED IN COLLECTING AND TRANSPORTING LATEX ON GROUND AT BASE OF SHELVES. CEYLON.

DUTCH BORNEO.

This is very much the largest and also the most backward portion of Borneo. What is said of rice cultivation in Sarawak will also apply here. In Sambas and Pontianak there are a good many coconuts and at the latter place there are said to be two steam mills for pressing out the oil.

At Kotei Bharu, on Pulo Laut, there are a number of pepper gardens. These gardens seem to have furnished the finest of the past year's crop. The experiment of using young cotton trees (*Ceiba pentondra* Gaertn) as supports for the pepper vines has been tried here, but seems not to have been entirely successful. Where this was tried the vines do not appear to be especially thrifty. The cultivation of para rubber in Dutch Borneo has scarcely been started. It is said that there are a few small plantations in West Borneo and small numbers of stumps have been set out at certain places on the east coast, but so far as is known the holdings are small and none of them are yet in bearing. It is probable that large areas in Dutch Borneo could be utilized for rubber and gutta-percha if men and money were available to develop the country.

At Bandjarmasin near the south coast great quantities of melons, pomelos, squashes, and chickens are raised and exported to points on the east coast, in the oil field, where there is no agricultural development.

FEDERATED MALAY STATES.

Para rubber (*Hevea braziliensis*) is the great crop of the Federated Malay States and the department of agriculture is spending a great deal of time in trying to improve its cultivation. There are very large areas in rubber in the Federated Malay States. Many of the older plantations are now in bearing. The laborers are Chinese, Javanese, Kling, or other imported coolies.

There are a number of young gutta-percha plantations in the States. These are mainly under the direction of the forestry department. Cultivation here consists in the opening up of the forest and partial clearing.

Bambong (*Ficus elastica*).—This rubber is cultivated on a few plantations but is not of so high a grade as the para rubber and is more expensive in cultivation. It is probable that its future use will be only as a cover for worn out lands, of which there are many in the tin-mining region.

Lalang.—This is the same pestilent grass which we call by the name of cogon (*Imperata spp.*) in the Philippines. Large tracts of land have been rendered useless by it. In places in the Federated Malay States it has been eradicated by spraying. Elsewhere frequent cutting to prevent fruiting has given a measure of relief. Possibly the most effective means of fighting it has been with the small vine (*Passiflora foetida L.*), which takes the ground from the lalang and is not hard to tear out after it has once occupied the land.

Coconuts.—In the Federated Malay States and Straits Settlements the authorities have had marked success in fighting the coconut beetle. Infested trees are treated and breeding places destroyed. The government employs two men as inspectors of coconuts and they see to the carrying out of the treatment and preventive measures. Owners of infested trees are required to destroy such trees or to have them treated in such manner as to remove the insects. Any persons harboring breeding places for the beetles are required to clean up their premises, destroying all refuse. Any failure to comply with the provisions of the law is punishable by fine and the work of cleaning up is done by the government at the expense of the owner of the land. The treatment of infested plantations has proved very successful. Trees which for a few years were not bearing or were in poor bearing have been treated and are now restored to a thrifty condition. It is estimated that the work of inspection and treatment of the coconuts saves the people many hundreds of dollars per year. I believe that we could very profitably do similar preventive work in the Philippines.

Bananas.—On the experiment station grounds, at Kuala Lumpur, there is a considerable tract of land planted with different varieties of bananas. I believe there are said to be more than 60 different kinds in the collection. Experiments have been undertaken to determine the value as a food product of banana flour, and the yield per acre. These experiments are in a very early stage in the Federated States, but they promise to be very valuable.

The wild banana is very plentiful in the Federated States. It has been thought that the fiber from it could be profitably extracted, but it is certainly inferior to the Manila hemp and the expense of handling it is greater.

Cassava.—In Malacca and some sections of the Federated Malay States the cultivation of cassava is in bad repute owing to the wasteful methods followed by the Chinese. Virgin soil is placed in cassava and gives crops for three years. After that the yield is poor and the land is allowed to go to lalang. This is so notoriously the case that in many places the Chinese are discouraged from taking up new land for cassava. Cassava seems to take a large amount of nourishment from the top soil. If this is replaced by artificial fertilizer, the land will remain in good condition to grow cassava for many years. This is the case in the Province of Wellesley where some land is said to have been in cassava continuously for thirty years. Cassava has been used with good results as a temporary crop for a young rubber plantation to keep out the weeds. I have also seen it used in similar fashion in a young coconut plantation. So far as I have been able to learn, the cassava raised in this section is used only for tapioca.

Rice.—Large areas are devoted to the cultivation of the irrigated or

lowland rice. In order to bring larger areas up to a high state of cultivation, the government has undertaken large irrigation projects. A single one of these, in the Krian District of Perak, has brought some 70,000 acres of rice land into a much improved state of cultivation. In this same district, the department of agriculture is undertaking a number of experiments in the effort to improve the common methods of rice cultivation. The government has here forbidden the cultivation of dry or upland rice, because of the areas of good jungle which are destroyed in the clearing for such a crop.

Protective belts.—Throughout the Federated Malay States there are being left at occasional intervals strips of jungle two miles wide, for the purpose of preventing the spread of plant diseases from one cultivated section to another. As the prevailing winds are not very well known these belts are made to take quite a number of different directions. The need of such special protective measures is marked in the Federated Malay States because of the very large areas which are being planted to the one crop of Para rubber, thus favoring the rapid extension of any plant disease which may once get started.

Fruits and vegetables.—I have made it a practice to visit the markets at each place where I have been and have been somewhat surprised to find that in none of the places visited does there seem to be so great an assortment of fruits and vegetables as is regularly to be found in the Manila markets. Our markets here contain nearly all of the fruits which are found in Borneo or Malaya and the quality is better than is found in most places.

Domestic animals.—The common draft animal is the Indian bullock. The carabao is also very common, particularly in the district where rice is the main crop. In certain portions of Perak there is a most strikingly large percentage of pink or albino carabaos.

In the State of Pahang there have been frequent and serious outbreaks of rinderpest, which have destroyed many of the carabaos and occasioned much distress.

THE AGRICULTURAL BANK OF THE PHILIPPINE GOVERNMENT.

By FRANK A. BRANAGAN,

Insular Treasurer, and Manager of the Agricultural Bank.

Before discussing the law creating the Agricultural Bank of the Philippine Government and describing the operations of the bank, a brief mention of similar institutions in other countries is deemed appropriate.

SOUTH AUSTRALIA.

In 1895 the State of South Australia provided by law for the loaning of money by the State to settlers and farmers. Capital was procured by the sale of mortgage bonds by the State, which were guaranteed by the government, and the loan operations are carried on by a State bank. Funds are loaned to farmers in aid of rural industries and to local branches of the government for the purpose of acquiring bridges, wharves, roads, and other permanent improvements and for the redemption of existing indebtedness. The loans are for any period not exceeding forty-two years, and when on the security of a freehold are for not exceeding three-fifths of the unimproved value of the land and the permanent improvements thereon, plus one-third of the value of any cultivation, the valuation not to exceed the amount of the last tax assessment of the property. On land leased from the government the bank will loan a sum not exceeding one-half of the sale value of such lease. Not over ₱50,000 can be loaned to any one person or company. Local authorities, or local branches of the government, may borrow not to exceed the cost of any works to be constructed or acquired, or the amount of the indebtedness to be redeemed. The security required from farmers is a mortgage on the land and a bill of sale of the buildings, etc., and from the local authorities a pledge of their revenue. Loans are repayable in semiannual installments of principal and interest, on April 1 and October 1. The interest must not exceed 5 per cent per annum. The borrowers pay the cost of inspection, appraisement, examination of title, registration of mortgage, etc. A general banking business is not conducted.

QUEENSLAND.

In 1901 the Parliament of Queensland created the Agricultural Bank of Queensland. The bank raised its capital by the sale of its bonds, and loans are made to owners of agricultural lands, or to persons occupying Crown lands as agricultural farms, agricultural homesteads, grazing farms, grazing homesteads, and miners' homesteads. The amount of the loan may not exceed 65 per cent of the value of the security, and not over ₱8,000 may be loaned to any one person. The interest charged is 5 per cent per annum, payable semiannually, and the principal may be repaid in installments. The borrower pays all expense of inspection, appraisement, examination of title, registration of mortgage, etc. Until the loan is fully repaid, the borrower may not subdivide or lease his land without the consent of the bank. Funds are loaned for the following purposes, viz:

(1) For the payment of liabilities already existing on the property.

(2) For conducting agricultural, dairying, grazing, horticultural, or viticultural pursuits.

(3) For adding to the improvements already on the property.

(4) For purchasing stock, machinery, and implements.

No loan may be made by the bank "to any aboriginal native of Asia, Africa, or the Pacific Islands."

When a loan is advanced in installments, interest runs from the dates the installments are advanced to the borrower.

A general banking business is not done.

NEW ZEALAND.

In New Zealand agricultural loans are made by a department or branch of the government known as "Government Advances to Settlers Office." The business of the office is the advancing of money in New Zealand on first mortgages of lands and improvements. Loans are made on the "installment system" or the "fixed-loan system," and the margins of security are as follows:

(1) On freeholds, three-fifths of the value may be loaned either on the installment or the fixed-loan system, provided that in the case of first-class agricultural freeholds installment loans may be made up to two-thirds of the value.

(2) On leaseholds, three-fifths of the value of the lessee's interest in the lease may be loaned on the installment system. No loans are made under the fixed-loan system on leaseholds.

(3) On urban or suburban freeholds, loans are made on the installment system only.

No loans of less than ₱250 nor more than ₱30,000 can be made, and in the case of urban and suburban freeholds the maximum loan is ₱20,000.

Fixed loans are for any period not exceeding ten years, and the principal is repayable at the end of the term. They may also be repaid in whole or in part on any half-yearly due date during the term. Interest is at 5 per cent, payable semiannually, reducible to 4½ per cent if payment is made not later than fourteen days after maturity. Installment loans are repayable in seventy-three half-yearly payments of principal and interest combined. They may also be reduced to 4½ per cent interest if payment is made not later that fourteen days after maturity. The borrower, in both cases, pays the cost of inspection, appraisement, examination of title, registration of mortgage, etc. No general banking business is done.

The operations of the office are described as follows: A man owning land used for farming, dairying, or gardening, makes application for a loan on a regular form and files the same with the superintendent of the office, inclosing a valuation fee. The superintendent immediately transmits the application to the valuer-general, who instructs the valuer for the district in which the land is located to make a report to the superintendent, for which service the valuer receives the fee paid by the applicant on submitting his application. The superintendent submits the application and the valuer's report to the general loaning board, which passes on the loan, allowing it in full or in part, or rejecting it entirely. The applicant is notified of the board's decision. If the loan is made, an account is opened with the borrower in the head office. The title to the security having been examined, value certified, mortgage drawn, etc., by the solicitor, a check for the amount of the loan is forwarded to him. He deposits it, and draws a check on the account, payable to the borrower or his agent, for the amount of the loan less the solicitor's charges. Interest and other payments are made to the Postal Savings Bank most convenient to the borrower, which bank forwards the amount, through proper offices of the Postal Savings Bank. The office has loaned something over ₱40,000,000.

EGYPT.

The sole business of the Agricultural Bank of Egypt is to loan money to small land owners. The loans are of two kinds, viz:

"A loans," from ₱5 to ₱200, which are repayable with interest in one sum the following crop season, but if made only two or three months before that time, they are not collected until the following year. The maximum period for these loans is fifteen months.

"B loans," from ₱100 to ₱3,000, payable in five annual installments at the crop season.

Never more than 50 per cent of the value of the land is loaned. The "A loans" have no special security beyond the crop, but the "B loans" are secured by a mortgage on the land.

Collections of principal and interest are made at the time the taxes

are collected, by the government tax collector, who is allowed one-half of 1 per cent on all collections he makes.

The following is the procedure that is adopted: Application blanks are had from the head man of each village. A landowner requiring a loan obtains one of these forms and fills up the part that concerns him. He then takes the application to the tax collector, who keeps the land register, and gets him to fill up and sign a certificate as to the ownership and incumbrances on the property. In the case of "B loans" he has also to get the village measurer to give the description and area of the land to be mortgaged. This having been done, the applicant presents his application to the bank's agent in the district, who, after consideration of the value, admits or rejects the application. If the application is admitted, the bank's agent sends it direct to the tax collector for him to fill up his second certificate. When the bank's agent receives the application back from the tax collector, he sends it to the head office of the bank in Cairo, where it is carefully checked and examined. If it is all in order, in the case of an "A loan," the bank at once issues a pay order to its agent to pay the amount to the applicant; in the case of a "B loan," a pay order is sent to the agent, but only after the mortgage on the applicant's land has been duly registered. The lists of sums to be collected by the tax collectors are prepared by the bank's agents, who likewise calculate the interest, and are sent to the head office of the bank, where they are checked. They are prepared separately for each village, and are sent to the ministry of finance, by whom they are passed on to the tax collectors with instructions to collect on the date of maturity. The interest is charged to the end of the month in which payment is due, and all money collected that month is credited to the bank by the government on the first of the following month, the government sending lists of collections made to the bank as soon after the end of the month as possible. In the case of "B loans," the registration of the mortgage is effected as follows: The agent of the bank in the district, at the same time as he sends the application to the head office of the bank in Cairo, also sends to the tribunal where the deeds have to be registered, a list of applications with description of the lands they propose to mortgage. In each tribunal the bank has a clerk, who on receipt of these lists checks them with the court registers of mortgages to see that there exists no legal charge already on the land. Although the tax collector has certified on the application that there is no such charge, this further check is necessary as the owner of the land may have mortgaged it and the tax collector not yet received the notice from the court. The bank's clerk at the tribunal after he has checked the lists, forwards a report to the head office of the bank at Cairo. If this report is favorable, the mortgages are at once prepared in the legal department of the bank, and notice sent to the applicants to appear on a certain date

at the tribunal where the mortgage is executed and registered. The cost is paid by the applicant.

A general banking business is not carried on by the bank.

OKLAHOMA.

When the Territory of Oklahoma was created the United States reserved two sections of land in every township for school lands. The Indian Territory, being composed entirely of Indian Reservations, had no school lands. When the two Territories were admitted into the Union as the State of Oklahoma, the United States donated ₱4,000,000 to Indian Territory for a school fund, so as to place her on an equal footing with Oklahoma Territory. This fund of ₱4,000,000, became, of course, the property of the State of Oklahoma, and to invest it an office was created and authorized to loan the money exclusively to farmers, on real estate security. The money loaned may be used for any kind of agricultural purposes, is repayable at any time in not exceeding ten years, draws 4 per cent interest per annum, and the borrower pays the expense of the abstract of title, fee for examination of title, expenses of inspection and appraisement of the property, and the recording fees, which expenses run from ₱30 to ₱70. About half the fund has been loaned.

THE PHILIPPINE AGRICULTURAL BANK.

The Agricultural Bank of the Philippine Government was created by Act No. 1865, of the Philippine Legislature, June 18, 1908. It is a body corporate, and has a separate and distinct entity from the Government, and possesses all the general powers of corporations. Its capital is ₱1,000,000, appropriated from the public treasury. The affairs of the bank are administered by a board of directors consisting of five members, three of whom are appointed by the Governor-General, and the Secretary of Department of Finance and the Treasurer of the Islands are ex officio members of the board. The Insular Treasurer is also ex officio the manager of the bank.

The bank is empowered to do a regular banking business, including the receipt of time deposits, at not exceeding 4 per cent, from the Postal Savings Bank, provincial and municipal governments, and others, and may establish agencies in the provinces for doing a similar business. The principal object in creating the bank, however, was to enable the farmers in the provinces to borrow money at a reasonable rate of interest, repayable at any time in not exceeding ten years.

The loans bear 10 per cent interest per annum, and the security required is a first mortgage on any of the following classes of property, viz:

(1) Unincumbered improved urban property.
(2) Unincumbered agricultural land.
(3) Gathered and stored crops.

The bank can not loan to exceed 40 per cent of the value of the property offered as security, and may not loan less than ₱50 nor more than ₱25,000 to any one borrower, and 50 per cent of the capital is set apart for loans of not over ₱5,000. Loans may be made for any of the following purposes:

(1) To redeem agricultural land from existing incumbrances.

(2) To pay the cost of constructing drainage works on agricultural land.

(3) To pay the cost of constructing irrigation ditches and dams.

(4) To purchase fertilizers.

(5) To purchase agricultural seeds.

(6) To purchase agricultural machinery.

(7) To purchase agricultural implements.

(8) To purchase carabaos and work animals to be used in agricultural work.

No money can be loaned except to persons engaged in agriculture, and it must be used exclusively for one of the above mentioned purposes. Persons applying for loans on real estate security are not required to have a certificate of title issued by the court of Land Registration (Torrens), but they must own the land in fee simple, by Torrens title, title of dominion, or otherwise.

The bank furnishes free of charge all necessary blanks for making application for loans, and any person wishing to apply for a loan may secure such blanks from the manager of the bank at Manila or from any provincial or municipal treasurer. There are no fees or commissions of any kind to be paid to any one by the person making a loan, except the cost of recording the mortgage to the bank at the time the loan is made. The interest begins to run the day the money is paid to the borrower, and runs until the money is repaid to the bank. If any partial payments are made the interest on the amount paid stops the day of such payment.

Anyone desiring to negotiate a loan procures and fills up the application blank furnished by the bank, and forwards it to the manager at Manila, where it is examined and recorded. If it is found in proper form, and otherwise correct, the manager forwards the application to the treasurer of the province where the land is located, for reference to and investigation by the provincial board. The provincial board sometimes refers the application to some one of its members or to the municipal president or treasurer in whose jurisdiction the land is situated. The manager requires a report as to the correctness of the applicant's statements concerning the land, as to the market value of the land and what it is assessed at for taxation, etc. When the application and report are received from the provincial board, the manager submits them to the board of directors of the bank, which either refuses or authorizes the loan. If a loan is authorized, a mortgage and promissory note are prepared

and sent to the applicant for execution. When they are returned by him, the mortgage and applicant's muniments of title are forwarded to the bank's legal adviser for his opinion as to the applicant's title and the sufficiency of the mortgage. If he approves, the mortgage is sent to the registrar, who records it, and notifies the manager whether the mortgage to the Bank is the first and prior incumbrance on the property. If it is, the money is paid to the applicant, or part paid to his mortgagees, or to others for him.

Collections of interest and principal of loans are made by the bank, or by any of its provincial agencies, and arrangements will probably be made with the Postal Savings Banks to make such collections in places where the bank has no agency.

The bank opened for business at Manila on October 1, 1908, and an agency at Zamboanga was opened for business on January 11, 1909.

IRRIGATION PROJECTS—REPORT BY THE IRRIGATION ENGINEER.

MANILA, P. I., *November 18, 1908.*

SIR: I have the honor to report on the status of the irrigation division and of projects received and investigated to date.

On June 25, 1908, authority was received for the following engineers:

2 assistant engineers	₱5,000
2 assistant engineers	4,500
2 assistant engineers	4,000
4 assistant engineers	3,600
4 assistant engineers	3,200
6 assistant engineers	2,800
2 Filipino engineers	1,800
2 Filipino engineers	1,600
2 Filipino engineers	1,200
2 Filipino engineers	1,000
24 surveyors	360

Of the above there are now assigned to the irrigation division the following:

2 assistant engineers	₱5,000
1 assistant engineer	4,500
1 assistant engineer	3,600
15 assistant engineers	2,800
2 Filipino engineers	720

and a varying number of surveyors.

Of the above two are on duty in the Manila office, myself and Mr. Larrison, who is acting as my assistant. There are five field parties comprising fifteen American engineers, two Filipino engineers and a number of surveymen. The other two American engineers are confined to the Civil Hospital with typhoid fever. One assistant engineer assigned to irrigation work was ill for over a month with typhoid fever and has been temporarily assigned to work on the Benguet Road to facilitate his convalescence. It is hoped that as soon as his health will permit he will be returned to irrigation work. The above force, together with one stenographer, completes the present force of the irrigation division.

Projects.—Authority has been received for either preliminary, further or final investigation of twenty-three projects. Preliminary reports have been made on fifteen projects and reports are pending on three projects

for which preliminary investigations have been completed. There are two projects in process of preliminary investigation. Final surveys have been made on one project and are in progress on three.

In addition to the above there are a number of reports from provincial boards which are under consideration and a large number of projects may be brought out from these reports.

The principal projects under consideration are as follows:

The Ambalangan-Dalim irrigation system, Province of Pangasinan; area to be irrigated, 12,000 hectares; water to be diverted from the Agno River; estimated cost, ₱500,000. A party of four engineers are now making final surveys, which should be completed by about January 1. Report can be presented to the irrigation committee by February 1 for consideration. Some construction may be begun in April, 1909, but the larger part will have to be done in the 1909–10 dry season.

The Pototan irrigation system, Province of Iloilo; area to be irrigated, 4,000 hectares; water to be diverted from the Suague River; estimated cost, ₱100,000. A party of four engineers are now making final surveys of the project. Their report should be ready for presentation to the irrigation committee by January 15, 1909. Designs would follow and work could be commenced as soon thereafter as practicable.

The Pilar irrigation system, Province of Bataan; area to be irrigated, 250 hectares; estimated cost, ₱4,500 to ₱6,000. The final investigation of this project has been finished, and the report with estimates and partial designs is in the hands of the irrigation committee. Construction may be begun as soon as certain questions regarding water rights and use of old dam can be settled. It is hoped that this work may be completed by April, 1909.

The San Miguel irrigation project, Province of Tarlac; area to be irrigated, 3,000 to 4,000 hectares; estimated cost, ₱100,000 to ₱150,000. This project is now under very complete investigation by a party of three engineers, and it is probable that final report will be ready by December 15, 1908. Designs would follow and construction could be begun at any time thereafter.

The Iba irrigation system, Province of Zambales; area to be irrigated, 400 hectares; estimated cost, ₱5,000. This project, which is the repair and reconstruction of an existing system, is under final investigation by a party of three engineers. This same party will also make preliminary investigations of eight or ten projects in the province of Zambales. Final report on the Iba project should be ready for presentation by January 1, 1909, and construction might be commenced in February or March with good prospect of completing the work by the beginning of the next rainy season.

The Dingras irigation system, Province of Ilocos Norte; area to be irrigated, 1,000 hectares; estimated cost, ₱20,000 to ₱30,000. This

project is now under final investigation by a party of three engineers. Final report should be ready for presentation by January 1, 1909, and construction may be begun as soon thereafter as funds are available.

In addition to the above there are several large projects to be investigated such as the Abra River project, and the Amburayan River project, both of which will cost upward of ₱500,000 to construct. An investigation of a project to use the waters of the Norzagaray River has been recommended to the irrigation committee.

Investigation has been authorized on a project in Pampanga and will be taken up soon.

There is also considerable preparatory work being done in seeking projects from information obtained from provincial reports and from other sources.

The projects which merit special attention are the Ambalangan-Dalim; the Pototan; the San Miguel, Tarlac; Iba, Zambales; Pilar, Bataan; and Dingras projects. It is probable that construction on any of these might be begun before July 1, 1909, and in one or two instances, namely, Iba and Pilar, might be completed before that time. The Ambalangan and Pototan projects are large and more time will be necessary for their construction. It will be necessary to proceed carefully on the larger projects on account of the lack of reliable data regarding the rivers from which water is to be taken. Structures must be designed to make the fullest possible use of the low water flow of the rivers and yet must withstand the enormous floods which are encountered here.

The attached tabulation entitled "Tabulation showing status of irrigation projects" shows the name and location of projects, the estimated area which will be served and a preliminary estimate of the cost of construction, the character of the investigations and reports, and the present status of projects.

The estimates on such projects as general investigations of Ilocos Norte, Abra River system, Amburayan River system, and Norzagaray River system are made from a general knowledge of the country obtained on inspection trips in these localities.

There is also attached an estimate of the probable expenditures or allotments before July 1, 1909, showing a probable disposition of the ₱250,000 appropriated by Act No. 1688 and the ₱500,000 appropriated by Act No. 1837 for irrigation projects.

The question of river gauging has been receiving considerable attention. One hundred gauge boards have been ordered and fifty have been received. Forty have been distributed and about twenty gauging stations are in operation. Current gaugings have been made of several rivers, but this part of the work has been delayed waiting the arrival of current meters ordered early in July of this year.

Instructions for establishing gauging stations, gauging rivers, and

for making investigations have been prepared and placed in the hands of the chiefs of parties together with sample copies of all money papers and reports necessary for the proper handling of the work. This division handles considerable correspondence regarding irrigation and other hydraulic subjects.

The greatest present need of the irrigation division is the services of one or two engineers experienced in irrigation design and construction. The present chief of the division now attends to that work, but the routine work of the division leaves little time for a studious consideration of design.

Respectfully submitted.

H. B. KIRKPATRICK,
Irrigation Engineer.

DIRECTOR OF PUBLIC WORKS, *Manila, P. I.*

Estimated expenditures of irrigation division to July 1, 1909.

Engineering expenses, November 1, 1908, to July 1, 1909:			
Salaries, 8 months, at ₱5,500			₱44,000
Subsistence and per diems, at ₱1,000			8,000
Instruments and equipment			14,000
Traveling expenses, at ₱500			4,000
Estimated for increases in force and promotions			3,000
Expenses of committee, travel, etc			5,000
Estimated for consultation on laws, etc			15,000
Total			93,000
Previously allotted	₱50,000		
River gaugings	10,000		
		₱60,000	
Exenditures to November 1, 1908	22,000		
River gaugings to July 1, 1909	10,000		
		32,000	
Balance available			28,000
Necessary to allot to carry division to July 1, 1909			65,000
Appropriations:			
Act 1688			250,000
Act 1837			500,000
			750,000
Allotments:			
Irrigation division committee expenses, etc		50,000	
River gaugings		10,000	
			60,000
Balance unallotted			690,000

Estimated expenditures of irrigation division to July 1, 1909—Continued.

Estimated cost of Ambalangan-Dalim project	₱500,000
Estimated cost of Pototan project	100,000
Estimated cost of Pilar project	6,000
Estimated cost of Iba project	5,000
Estimated expenses to July 1, balance	65,000
Total	676,000
Leaving an estimated unallotted balance on July 1, 1909, of	14,000
Status July 1, 1909:	
Appropriation for 1910	750,000
Unallotted balance for 1909	14,000
	764,000
Probable unexpended balance of allotments proposed above for 1909	500,000
To be expended by division in fiscal year 1910	1,264,000

Tabulation showing state of irrigation projects, December 1, 1908.

Name of project and location.	Area (hectares).	Estimated cost (₱).	Character of investigations and reports.	Present status.
Ambalangan-Dalim system, Pangasinan.	12,000	500,000	Preliminary and further investigations made and reported.	Under final investigation by party of 4 engineers.
Pototan irrigation system, Iloilo.	4,000	100,000	Preliminary investigation made and reported.	Do.
Pilar irrigation system, Bataan.	250	4,300 [a]6,000	Preliminary and final investigations made and reported.	Reports now in hands of the irrigation committee.
Iba irrigation system, Zambales.	400	5,000	Preliminary investigation made and reported.	Final investigation now being made by party of 3 engineers.
Dingras irrigation system, Ilocos Norte.	1,000	20,000 [a]401,000	do	Under investigation by party of 3 engineers.
San Miguel irrigation system, Tarlac.	3,000 4,000	100,000 [a]150,000	do	Investigation completed. Report in preparation.
Sibalom-San José irrigation system, Antique.	3,000	111,000	do	Laid on table by irrigation committee as Province did not accept double cedula.
Dinalupijan irrigation system, Bataan.	2,000	(80,100)	Preliminary investgation made on 3 projects. Reported.	Laid on table by committee as there is no demand for irrigation in the district. Population sparse.
Orion irrigation system, Bataan.	300	5,000	Preliminary investigation made and reported.	Waiting further information as to attitude of interested parties.
Orani River project, Bataan.	200	5,000	do	Held up as inhabitants of district are opposed to this project.
Balsik River control, Bataan.			Investigated and reported.	Committee filed papers, as action did not seem to be necessary.
Tanauan irrigation system, Batangas.	400	88,250	Preliminary investigation made and reported.	Papers are laid on table on account of high cost per hectare for installation.
Nagdasig Canal, Bulacan.		([b])	Investigation made.	Report in preparation, not exactly irrigation.
Marilao Well irrigation system, Bulacan.		([b])	Investigated and reported.	No action necessary on part of committee. Project is unimportant.
Canal—Calumpit to Malolos, Bulacan.		([b])	Investigated by district engineer. Report not received.	Awaiting report of district engineer. Absolutely no information at hand upon which to base estimate.

[a] In this total the higher figure has been used in every case.
[b] Information not available for estimate. Usually not purely irrigation project.

Tabulation showing state of irrigation projects, December 1, 1908—Continued.

Name of project and location.	Area (hectares).	Estimated cost (₱).	Character of investigations and reports.	Present status.
Norzagaray River system.	(20,000)	(1,000,000)		Presented to irrigation committee recommending investigation. Awaiting action.
Jalaur irrigation system, Iloilo.	(3,000)	(90,000)		Investigation recommended; awaiting action.
General investigation of Province of Ilocos Norte.	(20,000)	(1,000,000)		Investigation authorized. Awaiting available men.
Abra River system, Ilocos Sur.	(30,000)	(1,500,000)		Do.
Balaoan irrigation system, La Union.	2,500	4,000	Preliminary and further investigation made.	Awaiting report of district engineer on further investigation.
Bacnotan irrigation system, La Union.	1,500	30,000	Preliminary and further investigation made.	Do.
Amburayan River system, Lepanto-Bontoc.	(15,000)	(750,000)		Authority received for investigation; awaiting available party of engineers.
Barugo irrigation system, Leyte.	(3,000)	(100,000)	Preliminary investigation by district engineer.	Awaiting report from district engineer.
San Vicente Canal, Bayombong, Nueva Vizcaya.		([a])	Investigation made and reported.	₱11,775 appropriated by Act No. 1688. Awaiting further developments in river.
Bago irrigation system, Occidental Negros.	[b]4,000 [c]6,200	582,900	Preliminary and further investigation reported.	Held up by irrigation committee on account of high cost for rice land and uncertainty of irrigation for sugar land.
Silay irrigation system, Occidental Negros.	5,000	50,000	Preliminary investigation made and reported.	Laid on table, as there was not enough water for the system.
Sta. Rita-Betis, Guagua Canal, Pampanga.	600	40,000	do	Further investigation authorized. Awaiting available party of engineers.
General investigation of Province of Zambales.	(3,000)	(100,000)		Under investigation by party of 3 engineers.
Total		[d]6,257,150		

[a] Information not available for estimate. Usually not purely irrigation projects.
[b] Rice.
[c] Sugar.
[d] In this total the higher figure has been used in every case. Figures in parentheses are merely general estimates and are not based on investigations.

THE CROP-REPORTING SERVICE.

Having completed the year 1908, during which time the crop and live-stock reporting service has been much improved, it seems well to give a rough sketch of the work that has been accomplished, for the benefit of the corps of reporters who have contributed such valuable aid.

The crop-reporting service was established by the Bureau of Agriculture two years ago for the purpose of collecting and compiling statistical data pertaining to agriculture. Nearly all this time has been employed in preparatory work and overcoming the many difficulties which would necessarily arise in a country where agricultural statistics have never been worked upon systematically.

Toward the close of the year 1907 there were about 400 correspondents, who sent in an average of 374 reports, while in 1908 their number went up to 700, with an average of 517 reports, thus making an increase of 38 per cent. All of them are sending in their monthly reports on crops and live stock with fair regularity, besides an annual report in the form of a supplement or summary of the whole. A few of our correspondents send their reports only once in every two or three months, but this delay seems to result in a gain both in quantity and quality.

Considering the conditions which prevail in these Islands the results obtained in two years' experience of reporting on crops and live stock have been fairly satisfactory. Our informants are becoming more accustomed to the work and therefore more accurate in filling out our blank forms. Of course we must take into account the difficulties they have to encounter in getting information. In addition to the suspicion aroused by the questions asked the farmers and the unreliability of their answers there remains the great difficulty in estimating the extent of the lands under cultivation. In most municipalities which include insolated barrios considerable money and energy is involved in obtaining information. Correspondents of small means can not very well answer the purpose, nor can those who are at the same time public officials on duty.

Statistics are necessary to the advancement of a country. Without reliable statistics the agriculturist would not know what his country does or could produce, nor would the consumer or the exporter know what could be bought or sold.

In order that statistics may give a good working idea of probable production, it is necessary that the data given should approximate the

truth. In this alone lies the real value of statistics. The value, therefore, of our crop and live-stock reporting service is in strict accordance with the veracity of the data given by our correspondents, who are, we may say, the real agents and representatives in this work. The better and more exact their information, the more valuable are our statistics to the farmers, brokers, and merchants. The Government created this service especially for the agriculturists, therefore it remains for them to see that it is useful and beneficial.

Fortunately an Act has just taken effect, compelling the exclusive use of the metric system. This might give rise to some difficulties at first, but we feel sure that once in general use it will constitute a beneficial factor, especially to the agriculturists who have to deal with it.

For the information of the public in general and our correspondents in particular, we insert in the last pages of this number of the REVIEW a tabulated statement giving the area planted and crops of rice harvested during the year 1908. As soon as the work of compiling is completed we shall also publish similar statements on other agricultural products and live stock.

We request those who voluntarily help us in this work to write to us whenever they have any questions to ask regarding agricultural matters, as we wish to help them as much as possible.

STATISTICS ON RICE IN THE PHILIPPINE ISLANDS.

Province.	Amount of paddy produced in 1908.	Area cultivated in 1908.
	Cavans.	*Hectares.*
Agusan	1,000	29
Albay	82,000	7,000
Ambos Camarines	169,000	26,000
Antique	170,000	13,000
Bataan	246,000	3,000
Batangas	224,000	30,000
Benguet	12,000	1,000
Bohol	129,000	44,000
Bulacan	996,000	49,000
Cagayan	56,000	15,000
Capiz	614,000	56,000
Cavite	432,000	88,000
Cebu	35,000	8,000
Ilocos Norte	319,000	27,000
Ilocos Sur	339,000	28,000
Iloilo	313,000	69,000
Isabela	1,000	1,000
La Laguna	301,000	47,000
La Union	167,000	30,000
Lepanto-Bontoc	110,000	10,000
Leyte	173,000	22,000
Mindoro	22,000	3,000
Misamis	50,000	2,000
Moro	30,000	3,000
Nueva Ecija	568,000	67,000
Nueva Vizcaya	42,000	7,000
Occidental Negros	302,000	18,000
Oriental Negros	25,000	2,000
Palawan	193,000	5,000
Pampanga	557,000	45,000
Pangasinan	1,080,000	115,000
Rizal	162,000	6,000
Samar	77,000	6,000
Sorsogon	50,000	13,000
Surigao	52,000	3,000
Tarlac	1,442,000	183,000
Tayabas	219,000	24,000
Zambales	467,000	17,000
Total	10,227,000	1,093,029

CROPS PLANTED AND HARVESTED AND CONDITION OF SAME TAKEN FROM MONTHLY CROP REPORTS FOR THE MONTH OF DECEMBER, 1908.

[RICE.—This article is in the unhulled state.]

Province and crops.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Agusan (reports from 1 town):	*Hectares.*		*Hectares.*		
Rice		Good		100	Cavans.
Abaca		do		314	Piculs.
Coconuts		do			
Corn		Poor		150	Cavans.
Albay (reports from 9 towns):					
Coconuts		Good		621,000	Nuts.
Abaca	9	do	3,894	16,202	Piculs.
Sugar cane	5	Fair	18	14	Do.
Rice	570	Good	30	525	Cavans.
Ambos Camarines (reports from 21 towns):					
Rice	1,862	do	3,383	56,272	Do.
Abaca	105	do	2,995	11,710	Piculs.
Coconuts		do		988,600	Nuts.
Sugar cane	48	do	85	110	Piculs.
Antique (reports from 6 towns):					
Rice	10	do	542	8,130	Cavans.
Abaca	2	do			
Coconuts		do		8,003	Nuts.
Sugar cane	100	do	50	1,175	Piculs.
Bataan (reports from 5 towns):					
Rice	70	Fair	1,452	44,520	Cavans.
Coconuts		Good			
Corn		do			
Batangas (reports from 13 towns):					
Rice			425	12,350	Do.
Abaca		do	13	40	Piculs.
Corn	319	Fair		15	Cavans.
Sugar cane	10	Good	10		
Benguet (reports from 4 towns):					
Sugar cane		Fair			
Rice		do	26	349	Do.
Coffee		do	2	16	Arrobas.
Bohol (reports from 16 towns):					
Coconuts		Good		2,122,595	Nuts.
Corn	23	Fair	842	10,284	Cavans.
Rice	17,897	Good	626	6,032	Do.
Abaca	8	do	54	184	Piculs.
Bulacan (reports from 14 towns):					
Rice	1,925	Fair	30,151	282,200	Cavans.
Sugar cane	500	do	18		
Corn	20	do	20	2,100	Do.
Coconuts		do			
Cagayan (reports from 4 towns):					
Rice		do	7	280	Do.
Coconuts		Good		2,000	Nuts.
Sugar cane		do			
Corn	100	do			
Capiz (reports from 13 towns):					
Rice	1	Fair	415	11,985	Cavans.
Abaca	5,059	do	25	194	Piculs.
Coconuts		Good		121,600	Nuts.
Corn	5	Fair	12	150	Cavans.
Cavite (reports from 6 towns):					
Rice		Good	484	9,650	Do.
Sugar cane		do	4	120	Piculs.
Corn	41	Fair	1	2	Cavans.
Abaca		do	12	124	Piculs.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of December, 1908—Continued.

Province and crops.	Planted during month.	Condition.	Harvested during month.		
			Area.	Quantity.	Unit.
Cebu (reports from 21 towns):	*Hectares.*		*Hectares.*		
Rice	813	Good	1,065	17,021	Cavans.
Abaca	50	do	406	915	Piculs.
Corn	23,298	do	22,080	60,219	Cavans.
Coconuts		do		698,054	Nuts.
Ilocos Norte (reports from 6 towns):					
Rice		do	12,525	363,000	Cavans.
Coconuts		do		5,000	Nuts.
Sugar cane	67	do	51	500	Piculs.
Corn	9	do	2	3	Cavans.
Ilocos Sur (reports from 18 towns):					
Rice		Fair	20,552	175,988	Do.
Sugar cane	91	do	258	1,840	Piculs.
Corn	321	do	13	5,002	Cavans.
Coconuts		do		54,200	Nuts.
Iloilo (reports from 14 towns):					
Rice	6,500	Good	20,717	89,600	Cavans.
Coconuts		do		40,665	Nuts.
Corn	552	do			
Sugar cane	25	do	32	580	Piculs.
Isabela (reports from 3 towns):					
Rice	1,000	Fair	1,000		
Corn		Poor			
Tobacco	548	do	548		
Sugar cane	3	Fair	3		
La Laguna (reports from 14 towns):					
Rice	6,011	do	1,983	39,590	Cavans.
Corn	250	do	6	50	Do.
Coconuts		Good		700,000	Nuts.
Abaca	986	do	5	5	Piculs.
La Union (reports from 10 towns):					
Rice		do	12,910	112,617	Cavans.
Coconuts		do		62,800	Nuts.
Sugar cane	32	do	29	480	Piculs.
Tobacco	1,082	do			
Lepanto-Bontoc (reports from 10 towns):					
Rice		Fair	4,793	70,606	Cavans.
Corn	25	do			
Tobacco	27	do			
Sugar cane	26	do	25	400	Piculs.
Leyte (reports from 14 towns):					
Rice	184	do	957	11,742	Cavans.
Abaca	27	Good	1,637	10,100	Piculs.
Coconuts		do		419,453	Nuts.
Corn	503	Fair	665	9,840	Cavans.
Misamis (reports from 6 towns):					
Rice		Good	310	6,350	Do.
Abaca	27	do	240	2,662	Piculs.
Coconuts		do		538,492	Nuts.
Corn		do	300	2,700	Cavans.
Moro (reports from 2 towns):					
Abaca	5	do	50	651	Piculs.
Coconuts		do		25,000	Nuts.
Sugar cane	1	do	80		
Corn	10	do	50	300	Cavans.
Nueva Ecija (reports from 16 towns):					
Rice		do	22,663	699,150	Do.
Sugar cane	68	do	40	645	Piculs.
Tobacco	93	do			
Corn	14	do			
Nueva Vizcaya (reports from 1 town):					
Rice		Fair			
Sugar cane		do			
Tobacco		do			
Corn		do			
Occidental Negros (reports from 13 towns):					
Sugar cane	2,755	Good	8,505	175,350	Do.
Rice		Fair	4,335	56,800	Cavans.
Coconuts		Good		217,700	Nuts.
Corn	665	do	90	3,250	Cavans.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of December, 1908—Continued.

Province and crops.	Planted during month.	Condition.	Harvested during month. Area.	Quantity.	Unit.
Oriental Negros (reports from 10 towns):	*Hectares.*		*Hectares.*		
Rice	350	Fair	582	4,204	Cavans.
Abaca	151	Good	214	2,382	Piculs.
Coconuts		do		863,890	Nuts.
Corn	1,465	Fair	570	4,667	Cavans.
Palawan (reports from 1 town):					
Rice			45	50,000	Do.
Coconuts				40,000	Nuts.
Pampanga (reports from 8 towns):					
Rice		Good	5,946	49,500	Cavans.
Sugar cane		do	118	1,240	Piculs.
Corn	10	Fair			
Pangasinan (reports from 25 towns):					
Rice	2,000	Good	52,748	746,856	Cavans.
Coconuts		do		144,285	Nuts.
Sugar cane	160	do	325	7,770	Piculs.
Corn	140	do	28	520	Cavans.
Rizal (reports from 14 towns):					
Rice		Fair	26,462	140,170	Do.
Sugar cane		do	214	350	Piculs.
Abaca		Good			
Corn	13	do	5		
Samar (reports from 16 towns):					
Rice	1,103	do	560	2,053	Cavans.
Abaca	16	Fair	2,087	7,981	Piculs.
Coconuts		do		118,960	Nuts.
Sugar cane	3	do	8	40	Piculs.
Sorsogon (reports from 16 towns):					
Rice	9,946	do	3,702	3,864	Cavans.
Abaca	830	do	7,677	11,051	Piculs.
Coconuts		do		186,550	Nuts.
Sugar cane	20	do	71	3,030	Piculs.
Surigao (reports from 1 town):					
Rice	945				
Tarlac (reports from 9 towns):					
Rice	1	Good	55,555	601,300	Cavans.
Sugar cane	7	do	86	8,470	Piculs.
Tobacco	82	do			
Corn	9	do	4	200	Cavans.
Tayabas (reports from 14 towns):					
Rice	8,912	do	743	9,550	Do.
Abaca	3,261	do	99	311	Piculs.
Coconuts		do		2,717,254	Nuts.
Sugar cane	34	do	27	6	Piculs.
Zambales (reports from 4 towns):					
Rice		do	2,094	67,820	Cavans.
Coconuts		do		25,300	Nuts.
Sugar cane	7	do	29	600	Piculs.
Maguey	5	do	10	20	Do.

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of December, 1908.

Province.	Rice, unhulled, per cavan.			Abacá, per picul.			Copra, per picul.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Agusan				₱7.50	₱7.50	₱7.50	₱7.50	₱7.50	₱7.50
Albay	₱3.86	₱2.00	₱2.93	9.00	6.00	7.50	7.00	4.25	5.62
Ambos Camarines	5.00	1.50	3.25	15.00	4.50	9.25	7.75	4.00	5.87
Antique	2.50	1.75	2.12	22.00	12.00	17.00	6.00	6.00	6.00
Bataan	2.50	1.50	2.00						
Batangas	4.00	2.00	3.00	14.00	12.00	13.00			
Benguet	4.50	3.00	3.75						
Bohol	3.50	1.50	2.50	13.75	5.00	9.37	8.00	6.00	7.00
Bulacan	2.90	1.75	2.32						
Cagayan	4.50	3.00	3.75						
Capiz	3.55	1.30	2.42	16.30	10.00	13.15	7.00	5.00	6.00
Cavite	3.50	2.30	2.90	17.00	16.00	16.50			
Cebu	3.80	1.90	2.85	18.00	10.00	14.00	9.87	6.00	7.93
Ilocos Norte	5.00	2.50	3.75				8.00	8.00	8.00
Ilocos Sur	4.50	3.00	3.75						
Iloilo	4.50	1.50	3.00	20.00	16.00	18.00	8.00	6.00	7.00
Isabela	3.75	3.75	3.75						
La Laguna	3.50	2.50	3.00	17.00	8.00	12.50	6.00	5.00	5.50
La Union	3.00	2.00	2.50				8.00	6.00	7.00
Lepanto-Bontoc	5.00	2.50	3.75				6.50	6.50	6.50
Leyte	3.50	2.50	3.00	15.00	6.50	10.75	7.50	2.25	4.87
Misamis	3.30	2.00	2.65	14.00	7.30	10.65	7.50	7.00	7.25
Moro	2.00	2.00	2.00	15.00	10.00	12.50	7.00	7.00	7.00
Nueva Ecija	4.00	1.00	2.50						
Occidental Negros	3.75	2.00	2.87	15.00	11.00	13.00	8.00	5.00	6.50
Oriental Negros	5.00	2.50	3.75	15.00	7.00	11.00	10.00	6.50	8.25
Palawan	2.50	2.50	2.50				5.50	5.50	5.50
Pampanga	2.80	2.00	2.40						
Pangasinan	4.50	2.50	3.50				7.00	5.00	6.00
Rizal	3.00	2.00	2.50	8.00	8.00	8.00			
Samar	4.50	2.50	3.50	15.00	10.00	12.50	6.50	4.50	5.50
Sorsogon	3.75	2.00	2.87	16.00	5.00	10.50	6.50	2.00	4.25
Surigao	3.00	3.00	3.00	11.50	11.50	11.50	7.50	7.00	7.25
Tarlac	4.00	1.50	2.75				7.00	6.00	6.50
Tayabas	4.00	2.50	3.25	17.00	5.00	11.00	6.00	2.00	4.00
Zambales	2.50	1.50	2.00				6.00	2.00	4.00

Highest, lowest, and average prices of rice, abacá, copra, sugar, tobacco, and corn for the month of December, 1908—Continued.

Province.	Sugar, per picul.			Tobacco, per quintal.			Corn, per cavan.		
	High-est.	Lowest.	Aver-age.	High-est.	Lowest.	Aver-age.	High-est.	Lowest.	Aver-age.
Agusan							₱2.00	₱2.00	₱2.00
Albay	₱8.00	₱8.00	₱8.00				3.00	3.00	3.00
Ambos Camarines	8.25	4.00	6.12				4.00	1.50	2.75
Antique	2.70	2.70	2.70	₱22.00	₱22.00	₱22.00	2.00	1.50	1.75
Bataan									
Batangas	4.00	3.00	3.50				3.00	2.00	2.50
Benguet	4.00	4.00	4.00						
Bohol	5.00	3.50	4.25	20.00	20.00	20.00	3.50	1.50	2.50
Bulacan	7.00	5.00	6.00	17.00	9.00	13.00	3.12	2.00	2.56
Cagayan				10.00	10.00	10.00	3.50	3.00	3.25
Capiz	5.00	5.00	5.00	15.00	5.25	10.12	2.00	1.50	1.75
Cavite	3.70	2.50	3.10				2.30	1.50	1.90
Cebu	8.00	2.50	5.25	30.00	3.00	16.50	4.50	2.25	3.37
Ilocos Norte	8.00	2.00	5.00	19.00	4.00	11.50	3.00	2.50	2.75
Ilocos Sur	6.00	2.00	4.00	35.00	7.00	21.00	4.00	2.50	3.25
Iloilo	6.00	2.50	4.25	30.00	5.00	17.50	4.00	2.50	3.25
Isabela				10.00	10.00	10.00	2.50	2.50	2.50
La Laguna	6.50	3.00	4.75				5.00	2.50	3.75
La Union	6.00	3.00	4.50	9.00	9.00	9.00	3.00	3.00	3.00
Lepanto-Bontoc	3.00	2.50	2.75	8.00	8.00	8.00			
Leyte	7.00	3.00	5.00	50.00	16.00	33.00	3.00	2.50	2.75
Misamis	4.00	4.00	4.00	25.00	9.00	17.00	3.25	1.50	2.37
Moro	5.25	5.25	5.25				2.50	2.50	2.50
Nueva Ecija	7.50	2.00	4.75	12.00	7.00	9.50	2.00	1.50	1.75
Occidental Negros	4.50	3.25	3.87	35.00	30.00	32.50	3.00	2.00	2.50
Oriental Negros	3.00	3.00	3.00	25.00	7.00	16.00	4.00	2.50	3.25
Palawan									
Pampanga	6.00	3.80	4.90				2.25	1.50	1.87
Pangasinan	7.00	3.00	5.00	10.00	6.00	8.00	5.00	1.50	3.25
Rizal	6.00	3.75	4.87				2.00	2.00	2.00
Samar	7.50	3.00	5.25				3.00	3.00	3.00
Sorsogon	5.00	2.00	3.50	12.00	12.00	12.00	1.50	1.50	1.50
Surigao									
Tarlac	5.00	1.50	3.25	7.00	7.00	7.00	2.00	2.00	2.00
Tayabas	6.00	3.00	4.50	6.00	6.00	6.00	5.00	5.00	5.00
Zambales	8.00	8.00	8.00	25.00	25.00	25.00	2.00	2.00	2.00

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PLATE I. MANILA HEMP GROWING IN THE FIELD.

THE PHILIPPINE

Agricultural Review

VOL. II MARCH, 1909 NO. 3

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

THE THEOBROMA CACAO.

The attention of the readers of this number of the REVIEW is invited to the article on the cultivation of *Theobroma cacao,* or cocoa, by A. Fauchère. The world's market for cacao is at present supplied principally by South and Central America, the Antilles, Equador, Venezuela, Trinidad, the Guianas, Brazil, and Mexico. None of this product is exported from the Philippines, and the industry of growing cacao for home consumption is not well established. Practically all of the cacao beans gathered in different parts of these Islands are fermented and worked up into little balls or cakes which are used by well-to-do Filipino and Spanish families. However, the native cacao found in the tiendas of most towns is usually a very inferior article and many of the wealthier

families buy the cacao beans and make their own chocolate by crushing the beans with an iron or stone roller on a large stone made specially for this purpose. While crushing the beans, sugar and spices are mixed with them to give the desired flavor to the paste or butter produced, which when heated and diluted with water and milk makes the native drink called "chocolate."

There is but one chocolate factory of any importance in the Philippines and this is supplied with beans principally from Java, Ceylon, and America. Only very small quantities of cacao beans are furnished to the Manila market from Cebu, Laguna, Batangas, Mindanao, and other provinces. Cocoa, chocolate, and other forms of the cacao of commerce to the value of ₱423,312 were shipped into the Philippines last year, and at present there seems to be no good reason why this product should not be supplied by home producers and the cocoa and chocolate for home consumption prepared in home factories; if, in fact, cacao should not become an important export of these Islands, supplying a part of the demands of the world's market.

M. Fauchère is, without doubt, one of the best authorities on cacao culture. He writes interestingly and in detail on the subject and what he says should be of value to any one interested in this industry. This article will be continued in a later number of the REVIEW.

THE PHILIPPINES CARNIVAL.

The second Philippines Carnival has come and gone. The carnival is one of the most popular indications of harmony and progress in this country, and as such is deserving of great praise and credit. All nationalities in Manila and the provinces contributed to and enjoyed the Carnival to the fullest extent. There were no distinctions of race, color, or nationality. On the Carnival grounds all were on an equal footing and those race discriminations which in time past have so often been the occasion of embarrassments were, for the time being at least, forgotten. For bringing about better harmony between all residents in the Philippines, the Carnival deserves great credit.

This year more than ever before the Carnival has done much to break down the barrier of prejudice which has in past years been built up against us in the leading cities of the China coast. Our English neighbors have, for once at least, admitted that we are making good progress in the work of colonization, and have enthusiastically put themselves on record as saying that they will watch our future progress with greater interest and sympathy. The 1909 Carnival has made some genuine friends and sympathizers amongst our English neighbors. To this extent, the Carnival is bringing about harmony in the Far East, and there is being gradually built up a bond of sympathy in place of the barrier of prejudice between the nations responsible for progress in this part of the Orient.

The orientals are beginning to realize that the white peoples are really their friends and brothers, striving to bring to them the best things of western civilization. For this the Carnival deserves great credit, and its officials should be encouraged to greater achievement along these lines. The interest and coöperation of Hawaii, Japan, China, the Straits Settlements, Dutch East Indies, and Australia should be secured; all of whose interests and efforts are along similar lines to those of our own, and with whom we should work in sympathy and harmony for the best and largest results in commercial progress and civilization.

For us in the Philippines, the Carnival must have some substantial foundation and reason for our work and efforts; these, we believe, are primarily the industrial development of the resources of our own country—the Philippines. Otherwise, we can not hope to attract to our shores in large numbers each year our oriental neighbors. It is to be regretted that a larger number of the provinces did not take part in the Carnival and furnish exhibits of the products of their farms, shops, and factories this year. The Provinces of Pampanga and Bulacan, also the Moro Province, were represented with most creditable exhibits. Next year we hope that not less than twelve provinces will be represented, for only as the provinces take an interest and take part in the Carnival can it serve its highest purpose and be the success it should. The Carnival must be distinctly a Philippine Islands' carnival and not a Manila carnival in order to serve its purpose to the whole people. The REVIEW suggests the employment in the future of provincial agents to explain to the officials and the people in the provinces the benefits of the Carnival, and to secure their coöperation. Let the Carnival of 1910 be more truly a Philippine Islands' carnival in which the provinces take a leading part and have a controlling interest.

GOVERNMENT FARMS.

One of the best material evidences of the determination of the Island Government to encourage the development of agriculture is the establishment of Government farms and experiment stations, where certain important experiments in tropical agriculture are given a thorough trial and the farmers in the surrounding country are given the benefit. These farms and stations are actual demonstrations of progressive methods of agriculture, stock raising, and the lines of agricultural work in which the farmers of the respective sections are engaged.

In this connection, the article in this number of the REVIEW on the Government farm at San Ramon, which is now under the administration of the military government of the Moro Province, will be of interest and serve to give our readers an idea of the work and activities of one of these farms. This Bureau has established farms or agricultural experiment stations at La Trinidad, Benguet, in charge of Mr. M. C. Merrill;

La Carlota, Occidental Negros, in charge of Mr. F. E. Deason; Alabang stock farm, Rizal, in charge of Mr. H. J. Gallagher; Lamao Experiment Station, Bataan, in charge of Mr. Harold Cuzner; and the Baguio stock farm, at La Trinidad, Benguet, in charge of Dr. C. M. Morgan. Farmers living in the vicinity of any of these farms or stations are urged to visit them frequently, and to make known to the superintendent their difficulties in raising various crops, and to seek their coöperation in every possible way. In this way only can the Government experiment stations and farms fulfill their purpose and be the help they are intended to be to our Filipino farmers, who are the real source and foundation of the country's future wealth and prosperity.

AGRICULTURAL LITERATURE.

The attention of our readers is called to the list of periodicals now being received by the library of this Bureau, which appears on the last page of this number of the REVIEW. These periodicals are published in several different languages, many of them being in English, a number in Spanish, and some in French, Dutch, and German, covering the principal agricultural publications which can be obtained from the different Governments interested in tropical agriculture. An effort is being made to make the library as valuable and practical as possible. Late numbers of the periodicals mentioned in the list will be found on the tables in the library at the office of this Bureau, together with bulletins and pamphlets, published by the various branches of the United States Department of Agriculture, also by many of the leading colleges and experiment stations in the different States. There are a number of catalogues that may be of interest to agriculturalists, and everyone interested in this literature is cordially invited to visit the library where he will be welcome, and every assistance possible will be given in looking up literature along any line of agricultural research or progress.

RICE PLANTING IN HAWAII.[1]

During the season of 1907 the Hawaiian experiment station conducted some experiments in rice-growing which confirm conclusions reached by this Bureau that are of great interest to planters in these islands.

One of the most interesting of these experiments and one which gave a definite result was that undertaken to test the relative value, for Hawaiian conditions, of two distinct methods of planting; viz., the direct sowing of seed, as practised in southern United States, and the eastern method of transplanting which, as already mentioned, is generally adopted in Hawaii. Seed was broadcasted at the rate of 50 pounds an acre, and another lot of the same stock of seed was drilled in rows at the same rate. When well established the seedlings were thinned out to a stand of approximately 200,000 plants per acre, thus conforming as closely as possible with the number of transplanted plants per acre. One adjacent plot was set out with seedlings 20 days old at transplanting, and a second plot with seedlings 35 days old at transplanting. By far the best return of all—viz., 4,205 pounds of paddy and 4,024 pounds of straw per acre—was given by the plot planted with the seedlings 20 days old at transplanting. The cash value of the paddy return per acre from this plot was $105.12. The plot planted with the older seedlings and that on which the seed was drilled gave returns very nearly equal, but about $56 less in value than the return from the best plot. The plot on which the seed was broadcasted gave a return of slightly less value than the plot which was drilled.

[1] *Agricultural News,* Vol. VII., No. 164, August, 1908.

THE SAPODILLA TREE (CHICO).[1]

The sapodilla tree (*Achras sapota*), called the naseberry in Jamaica, is a native of Mexico and other parts of Central America, where it is known as the "Zapote chico," and is much valued on account of its different products.

The tree grows from 25 to 30 feet in height. It is very plentiful in some districts of Mexico, and its wood gives a most valuable timber. The wood of the sapodilla is of a clear, deep, reddish-brown color, very hard, but fairly easy to work until thoroughly seasoned, when only the finest edged tools have any effect on its surface. The grain is of such density that the wood sinks when placed in water. The British consul at Vera Cruz mentions that door frames and other interior work in houses, known to be over a century old, made from the wood of the "Zapote," are as good to-day as when first placed in position.

Experiments in the use of the timber in port construction, for forming supports under sea water, show that it is extremely valuable for this purpose, since, notwithstanding the influence of the water and the mud, the timber appears practically indestructible. In Central America the milky juice yielded by the tree on tapping the bark is evaporated and forms the chicle gum of commerce. The business of producing this chicle has become a large and prosperous one in Mexico; the amount exported in the past year being over 2,200 tons, valued at more than $2,000,000, Mexican currency. There is also an increasing output of chicle from British Honduras. This product is chiefly shipped to the United States, where it is used as the basis of chewing gum.

The sapodilla fruit is said to be much appreciated in America, and it stands shipment well. The trees are readily propagated by budding.

[1] *Agricultural News*, Vol. VII., No. 164, August, 1908.

THE VALUE OF HUMUS.

By Charles Beelar.

The most important fact about humus is that it is the principal source of the supply of nitrogen in soils. The Minnesota experiment station has found that an increase of 0.5 per cent of humus in soils means an increase of 245 pounds of nitrogen to each acre. On the other hand, if the supply of humus is allowed to decrease 0.3 per cent in four years, there is an annual loss of 146 pounds of nitrogen per acre over and above the amount removed in the crop. This shows conclusively that increasing the amount of humus in the soil increases the amount of the nitrogen in the soil; and the decrease of humus means a great loss of nitrogen, not only by being removed in the crop but by leaching away in the drainage waters and by escaping into the air as the humus decays.

Scientists tell us that the humus in soils is never devoid of nitrogen. This is especially true with the soils in arid sections. The humus of soils in New England, which had been farmed for years but had been kept in properly rotated crops was found to have from 4 to 5 per cent of nitrogen. The humus of the arid soils of California was found to contain as high as 16 per cent of nitrogen; while in the semiarid regions of Kansas, Colorado, and Texas the amount of nitrogen in the humus has been as high as 10 to 12 per cent.

The reason that humus contains nitrogen may be better understood when we know that the most of it in soils comes directly from albuminoids in organic matter. While it is true that a little of the nitrogen may be derived from the reduction of ammonium salts and nitrates, the most of it in soils comes from the albuminoids that at one time formed a part of the plants and animals that lived upon the soil. You can not deposit upon the soil an organic substance, whether it be from plant or animal life, that does not contain nitrogen in a greater or less amount. When the organic matter decays, the supply of available nitrogen in the soil is increased.

We have found that nitrogen is needed to promote the growth of plants; that if there is not a sufficient amount of nitrogen in the soil we can not have plants. Since this is true and since practically all of the nitrogen in soils comes from its humus content, we can see the absolute

necessity of humus in soils. All plants, except legumes, obtain their nitrogen from the soil. Legumes have the power to gather this element from the great store in the air, if there is not enough in the soil to promote their growth. Since plants must obtain their nitrogen from the soil and the soil's supply is obtained principally from humus, we can again see the importance of humus.

1. Nitrogen is the most expensive of the three elements needed by all plants. To grow the common crops more of it is needed than any of the three plant foods. Since it is the most expensive of plant foods and so much of it is needed in the production of crops, and its supply can be maintained without any material cash outlay, if we maintain the supply of humus, we can again see the great value of humus in the soil.

2. The presence of humus in soils promotes chemical action on the mineral elements in the soil which are not available at the time for the needs of the plants. The soil may be rich in phosphorus or potash, yet nearly all of these elements may be unavailable for the needs of the plant; they may not be in a state to be utilized so that the growth of the plant will be very slow. If the soil is rich in humus, the acids contained in the humus together with those of the character of crenic and apocrenic acids will act upon the insoluble elements and make them available for the plant.

3. Besides being the source of nitrogen and rendering the mineral elements already in the soil available, the application of humus adds plant food to the soil. Not only do all organic materials add nitrogen, but they all contain a greater or less amount of the other plant foods needed to make soils rich. This is especially true of manures voided by animals raised on the farm. Horses, cattle, hogs, sheep, and poultry void manure rich in nitrogen, phosphoric acid, and potash. The degree of richness, of course, will depend on the animal and the kind of feed and attention received. If the manure of these animals is added to increase the supply of organic matter, the supply of all three plant foods is increased by the amount applied in the manure.

4. Another influence that humus has on the fertility of soils is the fact that it increases the number of earth worms. The farmer's son who wishes to go fishing does not get his bait from the clay bank on the hillside; he knows that no fish worms can be found there. Instead he goes out behind the barn, where the manure has been thrown for years, and there in the black earth, rich in humus, he digs down and finds the worms. Earth worms of all kinds make their home in soils rich in organic matter. Their presence greatly increases the supply of available plant food. And in some cases they burrow down into the subsoil and on their return bring up a little of the mineral elements to increase the supply in the surface layer. This may seem like a very insignificant matter; but, after all, it is the little things that count in the fertility of soils. This is one of the little things.

5. Besides being valuable by directly increasing the supply of nitrogen and indirectly increasing the available supply of other plant foods, humus benefits the mechanical condition and texture of the soil. Soils rich in humus are better retainers of moisture than those with but little humus. This property of soils containing humus is of special importance in arid and semiarid countries. Where there is but little rainfall during the months when crops make their heaviest growth, it is important that the soil have the power to contain and retain moisture as long as possible. If the soil can not contain much moisture, no matter how much it rains before the dry weather comes, the excess moisture will drain off and just what the soil can contain is all the crop will have to draw from in the time of dry weather. If the soil can contain a considerable amount of moisture and has the power to retain it, there is a greater probability of saving the crop when the dry weather arrives.

Experiments show that soils rich in humus have the power to contain more moisture than soils deficient in it. This is true because pure humus will contain more moisture than sand or clay, and the more humus there is in a soil, the more moisture it can contain. It has been found that 100 pounds of sand will contain only from 25 to 29 pounds of water. If any more than this amount is applied it will leach through and pass off in the drains. One hundred pounds of clay will contain from 40 to 50 pounds; 100 pounds of garden earth, from 85 to 90 pounds; while 100 pounds of pure humus will contain as high as 190 pounds of water. In other words, the soil of a garden, rich in humus, will contain nearly four times as much moisture as sandy soil devoid of humus.

Not only is the soil rich in humus a better container of moisture, but it is also a better retainer. Experiments show that 88 per cent of the moisture in sandy soils will evaporate in four hours in hot dry weather such as is usually experienced in arid countries.

In garden loam, reasonably rich in humus, only 21 to 25 per cent will evaporate in that time. In other words, the garden loam will contain almost four times as much moisture as the sand bank and retain it almost four times as long. Since evaporation may be hindered by establishing a dirt mulch, and since a dirt mulch is more easily established in a mellow soil, rich in humus, it can be seen how valuable organic matter is to the soil in semiarid regions.

In addition to the above, humus causes the water in soils to rise nearer to the surface. Experiments show that farmyard manure will strengthen the capillary rise of soil moisture. King tells of an experiment where it was found that the surface foot of 1 acre of manured soil contained over 1 per cent more moisture than the same soil unmanured. This proves that the moisture in soils rich in humus rises to the surface. This experiment showed that there were over 15 tons more moisture in

the surface foot of an acre of manured land than in the same soil unmanured, while there were nearly 7 tons less moisture in the fifth foot below the surface of the manured soil than in the unmanured soil. The humus brought the moisture up where the crops could use it. Not only then does the soil rich in humus contain and retain more moisture, but it places the moisture where it will most benefit the crop.

Every farmer knows that the above is true. He knows that the garden plot will be moist long after the clay bank has dried out and become so hard that it can not be plowed. The reason lies in the fact that the garden contains a greater amount of humus and will contain more moisture and keep it longer than the clay bank will. Therefore the farmer, who would make it possible for his crops to get moisture longer in a dry time should increase the supply of humus or organic matter in the soil.

6. Then, too, organic matter makes the soil warmer. This may not seem important in southern soils, but nevertheless it is beneficial. It is especially important in the germination of the seed of early crops. The soil that will warm up first in the early spring will, in the majority of cases, make the farmer a larger profit than the soil that is backward about becoming warm.

Humus makes soils warmer for two reasons. First, it makes them dark in color; therefore the soil will absorb more heat than the lighter-colored soils. Black, well-drained soils will warm up earlier in the spring than light-colored soils. Second, the decay of the humus warms the soil. Wherever vegetable matter decays, there is a certain amount of heat generated. Consequently, those soils that contain a great deal of decaying humus will be warmer than the soils without humus. The decay of any substance is, after all, nothing more or less than slow burning. When anything burns, it produces heat. That humus warms every soil, the farmer is aware. Compare the garden plot in early spring with the clay bank and you can soon tell that the garden plot is ready to germinate seed several days before the clay bank.

7. Humus decreases the weight of soils. That is, it makes soils lighter and more easily cultivated. Rich garden soils weigh about 70 pounds per cubic foot; clay soils, about 90 pounds. The lighter the soil the easier it is to cultivate and the less liable it is to pack. It is more easily cultivated to establish the much-needed dirt mulch and to enable the plant to send its roots deep down into the soil.

THE GOVERNMENT FARM AT SAN RAMON.[1]

By Capt. WILHELM J. WHITE, *Superintendent.*

In 1866 an order was issued by the Spanish Government creating a commission to devise means for utilizing convict labor in the Philippines. The plan adopted contemplated a number of penal colonies, but for some reason only one was established and that, after much deliberation, was located on the coast 15 miles north of Zamboanga, and named San Ramon Blanco y Erenas, for the ranking military officer of Mindanao, later known as General Blanco of Cuban fame. The colony struggled along for many years making some progress in experimental work but suffering from mismanagement.

The original site had as its natural boundaries Talasayan River on the south, Lubugan River on the north, with the high range of mountains on the east, and the Pacific Ocean on the west. Aside from these boundary rivers, another, the River Sax, which rises far up among the mountains, crosses the immense tract of land and empties its clear, fresh water into the sea through four splendid estuaries. This river is the chief water supply of the colony.

Without waiting for approval of plans, an overseer was temporarily appointed late that same year, and prisoners from Zamboanga were sent out as laborers. They immediately set about clearing ground near the beach for cultivation, and building storehouses for the produce when harvested.

With all of these hopeful signs at the beginning, it was yet the land of "*mañana*," and the final celebration of the founding of the colony was not held until August 31, 1870.

For long years San Ramon was destined to be a center of experiments in the manner of government as well as in the variety of products.

The plan was that the governor of the colony be the commander of the Mindanao prison establishment, with an agricultural assistant who was to reside at the farm and receive ₱60 per month and one-fourth of the products of the farm. The laborers were all to be prisoners.

Later a captain of the Army was appointed director. In 1883 this

[1] From the *Mindanao Herald*, Vol. VI, No. 2, Feb. 3, 1909.

captain of the Army was given sole charge of the farm, prisoners, and military detachment stationed there as guard; but, in case of necessity he might appeal to his immediate superior, the commanding general of Mindanao.

Don Felipe Dujioles, a captain of infantry and an agricultural expert, was later appointed director. He had studied for the degree of agricultural engineer, but failed to complete his course owing to the breaking out of the war in Spain in 1876. The work under his supervision was carried out in a proper manner; and it was owing to his untiring efforts that a sugar mill was erected with an alleged capacity of 6,000 piculs per day, and a sawmill with a daily output of 800 cubic meters of lumber.

During the administration of Don Felipe, the boundaries of the farm were somewhat extended, until it included 2,000 hectares. Other changes were made in 1889, and again in 1894, when a lieutenant-colonel was appointed technical director, who was also required to be an engineer. He chanced to be, fortunately, a laborious and conscientious man, and under his direction the colony recovered from the miserable condition that had previously existed.

Fifty prisoners were put to work, and they cleared ground for new buildings, laid out new fields and planted corn, and later indigo, cotton, tobacco, sweet potatoes, and other useful plants. The different altitudes, kinds of soil, and the drainage system of San Ramon proved that these plants, as well as many others, can be advantageously cultivated, provided the soil is well selected and the young plants protected from the ravages of wild animals. However, all these plantings yielded rather poor returns.

Sugar cane was tried, at first only in a small way in the rude wooden mill which had been previously constructed, but the quality of the sugar was very inferior. Later a steam sugar mill was procured, through Mr. John Foreman, the historian, and the capacity and the quality increased and improved.

When the prisoners were not cultivating, harvesting, and marketing the sugar, they were employed in molding and burning brick, getting out timber, sawing lumber, building bridges and roads, and clearing new land for cultivation. On the San Ramon farm is to be found an abundance of timber of all the superior groups.

In 1899 the outbreak between the Spaniards and the people of Zamboanga took place, and that same autumn, with American occupation of Mindanao, all the prisoners of San Ramon, said to number between 1,000 and 1,600, were turned loose. All the buildings, warehouses, etc., were burned to the ground, except the sugarmill and sawmill buildings, which were of substantial material with brick pillars and corrugated iron roofing, and one or two dilapidated frame buildings near the sea. Besides these a few scattered plots of hemp and about 5,000 coconut trees, which had been planted during the past quarter century, were our inheritance.

The convicts, many of them *deportados* from other islands, some of them criminals of the worst type, and others political offenders, were liberated. Among the ignorant and depraved liberty often means license, and this proved no exception to the rule. What was to become of these men? In highly civilized, Christianized countries, the ex-convict alone knows that the hardships he faces when turned out are often greater than the lack of liberty while incarcerated. But what of men, many in a strange island, speaking different dialects, ignorant and untutored, with an inborn fear of the Moro tribes which completely surrounded them?

Sometimes with clothing too meager to be described, these poor wretches went forth about the neighboring villages and found homes, thus finally becoming an amalgamated part of the community. Many remained on the farm, as they had been there for many years and had not the ambition to begin life elsewhere. When it was explained to them that a new Government was in control, that Spain no longer held her power, they only shrugged their shoulders in that passive way and stayed on.

When the American Insular Government took charge of the farm these men were given employment. Some of them are still at their posts; others have taken up land and built homes for themselves, while others have wandered away to live without work.

Mr. George M. Havice was the first civilian superintendent appointed. He took charge late in 1901. During his administration many coconut trees and abount 75,000 hemp plants were set out. The superintendent's residence which had been begun by the military authorities—who were in control of the farm during the interim between the Spanish evacuation and the taking in charge by the Insular Government—was completed. Hemp sheds were built and nipa cottages erected for the exprisoners then employed as laborers. During the time laborers were employed their pay, together with the salary of the superintendent and a clerk, left a large deficit each year.

Upon the organization of the Moro Province in 1903, General Wood, the first governor of the province, saw great possibilities on San Ramon if economically managed. It was an easy problem to persuade the Insular Government that economically as well as geographically San Ramon should be administered by the Moro provincial government. They were as glad to lay down the burden as we were to take it up.

The writer was appointed superintendent under the new government on December 16, 1905, and has continued as its superintendent to the present time.

When General Bliss assumed command of the Department of Mindanao in 1906 and became governor of the Moro Province, his interest in agriculture was manifest from the first, and his fostering interest in

San Ramon farm has been a great incentive to its ultimate success. The uncertainty of labor proved a menace for some time, but in May, 1907, the legislative council of the province relieved the situation by sending a few Moro prisoners from the provincial prison as laborers. The experiment was a happy one, and as accommodations could be provided for them more have been utilized. A modern iron-barred and concrete-based jail has been erected, and with the opportunities of securing plenty of fresh fish, vegetables, and other wholesome food, and with good treatment, the prisoners have been well and contented with but few exceptions. Their labor has been satisfactory at all times. They have been taught to do almost all kinds of skilled and unskilled labor; among them are stone masons, carpenters, bricklayers, and blacksmiths. They have become accustomed to the use of improved farm implements, many of them being able to plow with a double yoke of oxen and an American plow. They do good work and seem to take an interest in it. Under the direction of an expert several of them have become good hemp stripers. At the present time more than three-fourths of all of the labor on the farm is done by prisoners. The regular prison wage for all the prisoners employed is paid by the farm into the provincial prison fund.

During the typhoon of September last the River Sax changed its course, and where once there stood a thriving field of hemp and young coconut trees there is now a huge basin of boulders with streams running through it. The soil was washed away to a great depth and some of the oldest bearing coconut trees on the farm went down to the sea. Along the beach great numbers of bearing trees were washed out, the sea wall was washed away, and it is hard to estimate the loss of young nuts that were blown off by the storm. For days the streams were full of young nuts washed down from the slopes.

The main object of the provincial government has not been to operate the farm as a money-making proposition, but that it should be a factor in the development of new private plantations, making the necessary experiments for the planters, furnishing them with seeds, seedlings, and plants at a less cost than they have had to pay heretofore, especial care being taken to assure their being well selected and the best in the Islands.

The seed and plant business has grown so in the past year and a half that I anticipate that over one-half of the entire coconut crop of the farm will be used for seed during this year. In the past we have been unable to furnish these seeds and plants as regularly as the planters desired them, owing to poor transportation facilities, but under the new arrangement of schedules of the subsidized steamers the facilities are excellent, the seeds and plants being carried without transhipping, from the farm direct to the planter's very door. Already we have orders booked (November 1, 1908) for over 60,000 selected coconuts for planters at Davao, Malabang, Siasi, Parang, and other places throughout the province, many of which are now ready for shipping. We have many

inquiries from capitalists in the United States regarding suitable land for coconut planting, the problem of labor, the approximate amount of capital required for the development of plantations, and if we would be able to furnish seeds in case a proposition is consummated. So that the San Ramon farm will be one of the important factors in the development of the virgin fields of the Moro Province.

That the farm has been self-supporting is not due to any increase of products over former years, but to the economical utilization of labor and to the adoption of improved implements and modern methods of operation. During the next two years the coconut crop will be greatly increased by several thousand young trees coming into bearing. General Bliss, the provincial governor, has always insisted on reinvesting the profits from the farm. So that out of the first year's profits new implements were furnished, which have greatly aided us in the farm operations. From the profits of last year mules imported from America were purchased, which are a great addition to the farm. With the increase of revenues the first addition that will be made will be the purchase of some improved breeds of calves for the purpose of live-stock raising. Arrangements are being made for the purchase of these calves, which will be immunized against all the prevailing cattle diseases, and by the time they are old enough for breeding purposes they will be thoroughly acclimated. The result can not fail to be profitable and beneficial.

We have communications regarding breeding cattle from planters throughout the province who want a good breeding animal to improve the herds of native cattle which they now own. In this way the farm will again be able to help the planters and build up a most profitable, but for many years a wholly neglected, industry.

Among the experiments at the farm is the nursery of all kinds of citrus fruit, ornamental shrubbery, shade, and other trees. It has been proven that the finest quality of citrus fruits can be grown here; that the average lemon tree bears as much fruit as in any part of the world. A tree on the farm commenced bearing in December, 1907; it has been continuously bearing ever since and we have gathered from it over 200 good lemons and will be able to gather at least 50 more. At this rate of production this tree alone would bring in a revenue of ₱12.50 a year, which is about as much as the product of six coconut trees. The demand for such fruit has never been regularly supplied by the imported product, and one can not estimate how great the demand would be if a regular supply could be furnished fresh from the trees; but it is safe to say that this can be made a profitable business with small capital on a small area. We can furnish the young trees in small quantities at any time, at the actual cost of germination; we will also gladly furnish information regarding the culture of such fruits.

THE NEW MANIHOTS.[1]

By Dr. E. C. Waterhouse.

During the last two years and especially this year great interest has been aroused in some new species of Manihot rubber trees, which from all accounts are far superior to *Manihot glaziovii,* and should be of special interest to the rubber growers of Hawaii from the fact that the *Manihot glaziovii* or Ceara rubber tree grows and yields so well in Hawaii. If these species do as well as the Ceara, it will be well worth the while of the rubber growers of Hawaii to pay particular attention to them in future plantings. Some of the reasons why will be forthcoming later in this paper.

The export of rubber from the State of Bahia has increased more than ten fold within six years, having risen from 100 tons of very inferior rubber in 1900 to over 1,100 tons of a very superior grade of rubber in 1906. This led to an investigation of the sources of this new supply and the discovery that instead of the low grade of Mangebeira, formerly gathered, the supply came mainly from three new and valuable varieties:

1. *Manihot dichotoma,* or Jiquié Manicoba;
2. *Manihot heptaphylla,* or Sao Francisco Manicoba;
3. *Manihot piauhyensis,* or Piauhy Manicoba.

These varieties were so named by Dr. Ule, so well known as an authority on the classification of the different species of rubber trees, who visited the State of Bahia and neighboring states in 1906 to look into the sources of this supply.

Until six years ago *Manihot glaziovii* was considered the only rubber yielding species of its genus, though there are 82 species recorded which will soon be 100, when all of those discovered are described. It was only in the early part of 1906 that even the Kew Gardens, the birth place, so to speak, of the rubber industry in the Far East, always on the lookout for new species of rubber, were aware of the existence of rubber-yielding trees closely related to the commonly cultivated *Manihot glaziovii.*

All of these species, from all accounts, not only yield considerably more latex than the Ceara, but what is of very much more importance in

[1] From *The Hawaiian Forester and Agriculturist* for December, 1908.

Hawaii, the amount which one man can collect is much greater; in other words, the cost of collection is considerably less. This is a most important item here owing to the high price paid for labor, and, in fact, the point upon which the whole success of the rubber industry in Hawaii hinges.

A notable fact in this connection, one which will appeal to any one who has had any experience in tapping the Ceara, is that in these new varieties, in shedding the bark, longitudinal slits are formed and the membranous bark peels off in more or less vertical rows. This allows its removal much more easily and therefore more cheaply than is the case with the Ceara.

These varieties of Manihot like the *Manihot glaziovii* or Ceara have a very dry habitat. However, as we find that here in Hawaii the Ceara does better in wet localities, the same may be true with these varieties. That the Ceara does better here where it is wet I think there is no doubt. I have myself, in a little experiment station of my own, tried watering some plants and leaving others in the same soil unwatered; the watered plants far outstripped those unwatered and seemed to have as much or more latex, though the trees are still too young to draw conclusions as to yield.

In regard to these three varieties:

(1) MANIHOT DICHOTOMA.

The seeds of this variety are much larger than those of the Ceara. Germination takes place in two to three weeks if unfiled, the shell being much softer than in the case of the Ceara. The soil upon which this tree flourishes in variously described as red clay and red loam. The bark of this tree is thinner and more delicate than that of the Ceara.

(2) AND (3) MANIHOT HEPTAPHYLLA AND MANIHOT PIAUHYENSIS.

The seeds of these two varieties can hardly be distinguished from each other; they are only a little larger than the Ceara seeds. They do not germinate nearly as well as in the case of the *Manihot dichotoma.* These two varieties in the region around Bahia thrive in a sandy soil, growing largely on sandstone mountains. Neither of these varieties grow as tall as the *Manihot dichotoma;* they are also smaller and inclined to branch low. They are not affected by the wind so much as Ceara, probably on account of being smaller and more low-lying. This also affects the methods of tapping, as explained later. The foliage is characteristically green and fresh looking.

Methods of planting.—There are a number of plantations around Bahia, some of which are now three or four years old. They are planted for the most part 1,000 trees to the acre. This close planting has been adopted because the trees are planted in a dry locality and it is claimed

that if not planted so closely, or say 200 to the acre, the ground would be baked so hard and dry that the trees would dwindle and die. Also the trees are considerably smaller than other varieties and consequently need less room.

Methods of tapping.—In the case of the *Manihot dichotoma* the bark of the trunk is tapped and an instrument curved at the tip is used. The herring-bone or a single cut is used. Cups are used to receive the latex. The latex coagulates quickly on exposure to air but apparently not too quickly to prevent its flowing down into the cups well. Water is sometimes used in the cups to prevent too rapid coagulation.

In the case of the *Manihot piauhyensis* and *Manihot heptaphylla* the shorter trunk and somewhat thinner bark than the *Manihot dichotoma* are not suitable for cutting and by this method yield little latex. A little earth, however, is scraped away from the base of the tree, the top of the taproot is exposed and an incision with a round-pointed knife is made at or near the junction of the taproot and the trunk, and the latex flowing into this hole coagulates and is gathered therefrom. Often the collectors coat this little hole with clay to keep the rubber cleaner. Cups have been used but there is some difficulty in getting them into the hole thus made and the method is little used at present in collecting from the wild trees, but will doubtless be worked out on plantations.

Yield of the trees.—This is variously stated to be all the way from $2\frac{1}{2}$ to 11 pounds per year. Though of course these statements are made in regard to the gathering of the rubber from wild trees which are more or less ruthlessly tapped, and especially in the case of the *Manihot dichotoma* the wood is thus often injured severely and the tree dies. Also it is probably wet rubber that is spoken of and in some of it, especially the *Manihot heptaphylla* and *piauhyensis,* there may be considerable dirt.

Dr. Ule considers that the *Manihot dichotoma* has the advantage of its caoutchouc bringing a somewhat higher price. On the other hand, the amount produced in the other varieties is considerably greater, according to him. He therefore prefers these latter varieties, which he considers will supplant the Ceara for the dry and less fertile areas where Ceara is cultivated. There is no doubt, however, that all of these varieties yield more than the Ceara.

Amount of latex collected by one man in one day.—This has been variously stated at from 1 to 8 or 10 pounds. Taking into consideration the tendency to exaggeration in regard to any new product and misleading methods of figuring, still it is generally conceded that considerably more can be collected in a day from these varieties than from the Ceara.

Several thousand seeds of the *Manihot dichotoma* or Jiquie Manicoba were imported by Mr. Jared Smith, and most of the rubber plantations have obtained some of these. I have planted a few of these seeds. When filed they germinated in a few days and have grown very well,

fully as well as the Ceara so far, in spite of the fact that this is the wrong season of the year for planting. The leaves have red ribs, especially when looking up through them with the sunlight shining through. Those obtained at the Kew Gardens had whitish green ribs which, it has been suggested, might be due to artificial cultivation there. I intend to try watering some of the trees very heavily and letting others have only the rainfall, which if dry weather keeps up will be a slight test as to whether it will thrive best in a dry or wet locality here in the Islands.

So far I have watered all the young seedlings and they have done very well. Seeds of this variety are the only ones so far obtained. But it is doing very well when we remember that not even the Kew Gardens nor the gardens in Ceylon, Singapore, etc., have been able to obtain these other two varieties, though they have been seeking to do so for two years. The Peradeneya Gardens of Ceylon have 100 seedlings of *Manihot dichotoma* growing, also the Singapore and Penang Botanic Gardens. The Peradeneya Gardens are constantly asked for seed, which they can not as yet supply, for planting in the dry lands of Ceylon where the *Hevea braziliensis* can not be grown. We must not, however, forget, that the rest of the tropical world always thinks of these varieties as well as the Ceara in connection with a dry region, and it was only because we found trees of the Ceara variety growing and yielding so well in our wettest localities, as in Nahiku and Puna, and so much better than in the dryer localities, in and around Honolulu, that we decided, what subsequent plantings have all tended to confirm, that wetter localities, if not too cold, are better for the Ceara than the dryer ones here in the Hawaiian Islands. Still it would be a wise thing to plant some of these *Manihot dichotoma* in some dry places for experiment.

Dr. Ule says: "If, as is probable, the cultivation of *Hevea braziliensis* will undoubtedly obtain the greatest importance for the production of rubber in luxuriant tropical regions, the future has to look to *Manihot heptaphylla* and *Manihot piauhyensis* as the rubber plants for the dry and less fertile areas." Of course it is only fair to say that other observers speak as highly of *Manihot dichotoma*, which he has left out in this statement.

To sum up then, there are several reasons why the planters of Hawaii should direct their attention to these varieties.

1. In the first place, the industry in these Islands is in its infancy and we should endeavor to test all the different varieties of rubber-yielding trees which seem to promise well, for we do not yet know which species will prove the best in the long run, all things considered, such as early yield, cheapness of installation, length of yield with constant tapping, amount of yield, cheapness of collection, quality of the rubber obtained, etc., a balancing of all of which will give us finally the best species to cultivate most largely. The present plantations must

necessarily do a great deal of pioneer work in this line, if we consider the industry for the Islands as a whole. After the present companies have shown what can or can not be done commercially with the different species, no doubt many plantations will follow this lead.

2. These varieties in their habitat yield considerably larger quantities than the Ceara and yet thrive under very similar conditions to those in which the Ceara thrives, the variety which so far has proved to grow best here.

3. Most important of all here, are the varieties which promise the lowest cost of collection which, quality being equal, is, as I have said, the pivotal point in regard to the whole industry in Hawaii.

EXPERIMENTS IN TAPPING CEARA RUBBER TREES.[1]

The rubber experiments which are being carried on by the United States experiment station and territorial board of agriculture and forestry have been under way long enough to indicate certain results which are of practical importance to rubber growers. Thus far more than 200 trees, most of them less than three years old, have been tapped. These trees averaged from 12 to 13 inches in circumference and were located chiefly on the grounds of the Koolau Rubber Company, on Maui. In tapping young trees it was not expected that profitable returns of rubber would be obtained; but the plan involved the practical point of determining the rapidity with which trees could be tapped, and satisfactory methods of handling labor to the best advantage. In the first series of 80 trees, which were tapped by means of one vertical cut each day, it required thirty-six hours and forty minutes of labor to tap the trees, collect the latex, and secure 1½ pounds of dry rubber. In the second series of experiments on 160 trees, which were tapped with two vertical cuts instead of one, it required only forty hours of labor to tap the trees, collect the latex, and obtain 5 pounds of first-class rubber and about a pound of scrap rubber. In this experiments in which two vertical cuts were used daily, profitable returns were obtained.

It was found that an ordinary laborer could tap rubber trees by means of two long, vertical cuts at the rate of about 50 trees an hour and could collect latex at the rate of 100 trees an hour.

The available labor on plantations appears to be reasonably effective in doing this work, and the amount of training required in order to make the cuts effectively and quickly is not excessive.

It requires less time to tap older trees than young trees upon which our work is done, and there is also less danger of injuring the trees. We have found that a good flow of latex can be obtained from tapping done between daylight and 8 a. m., or even later.

From the experiments which we have thus far conducted it appears that one man can tap about 50 trees per hour, while another man can collect the latex from the trees which would be tapped in the same time by two men. Since it appears from results which we have obtained from

[1] An address by Dr. E. V. Wilcox, director of the Hawaii experiment station, at the second annual meeting of the Hawaiian Rubber Growers' Association, November, 1908. Reprinted from *The Hawaiian Forester and Agriculturist*, December, 1908.

tapping mature Ceara rubber trees, that about one-third ounce of dry rubber may be expected as a daily yield, it is evident that three men should be able to obtain rubber from mature trees at the rate of about one pound per hour. The data upon which this conclusion is based have been carefully considered and the estimate is probably not above what may be expected. At any rate, the results obtained in our experiments indicate clearly that the Ceara rubber tree in Hawaii will not only grow and thrive, but will yield profitable returns.

Further experiments will be carried on in the microscopic examination of sections of the Ceara rubber tree to get a basis for determining the best method of tapping. Several other species of rubber trees will also be tapped and an elaborate series of fertilizer experiments with rubber is planned. We hope to be able to devise a method of fertilizing rubber trees so as to secure an increased flow of latex during the tapping periods.

International trade in india rubber, 1902–6.[a]

EXPORTS.

Country.	Year beginning.	1902.	1903.	1904.	1905.	1906.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Angola	Jan. 1	2,564,948	6,137,046	5,617,377	[b]5,200,000	[b]5,200,000
Belgium	do	13,016,353	14,088,566	16,335,876	14,997,420	16,940,908
Bolivia	do	4,195,380	2,912,381	4,915,638	3,728,726	[c]3,728,726
Brazil	do	63,122,428	69,923,121	70,251,499	78,027,329	77,073,991
Dutch East Indies	do	426,848	1,475,551	3,590,489	4,569,275	4,564,932
Ecuador	do	870,405	1,090,988	1,145,447	1,293,134	1,394,575
France	do	6,011,956	6,390,101	6,632,627	10,766,377	13,033,578
French Guinea	do	[b]2,426,000	3,280,045	2,952,245	3,121,366	[c]3,121,366
French Kongo	do	1,518,469	1,857,491	2,753,778	3,716,860	[c]3,716,860
Germany[d]	do	13,748,023	11,237,840	10,073,138	18,654,850	12,589,053
Gold Coast Colony	do	1,599,974	2,258,981	4,013,837	3,687,778	3,649,668
Ivory Coast	do	2,011,471	2,572,379	3,386,399	2,602,638	[c]2,602,638
Kamerun	do	935,441	1,822,144	1,920,354	2,141,777	2,537,540
Kongo Free State	do	11,795,724	[b]13,350,000	[b]10,040,000	10,718,358	10,690,060
Netherlands	do	3,544,851	3,231,008	3,998,671	5,760,814	5,605,388
Peru	do	3,749,760	4,648,000	4,896,298	5,598,785	[c]5,598,785
Senegal	do	1,212,262	1,801,957	2,208,623	2,242,786	[c]2,242,786
Singapore	do	920,533	1,441,200	3,026,133	5,053,067	[c]5,053,067
Southern Nigeria Protectorate.	do	865,834	1,177,803	2,408,926	2,842,831	3,434,279
Venezuela	July 1	1,673,308	1,794,626	[e]2,429,461	3,064,296	[c]3,064,296
Other countries	do	4,664,000	5,970,000	8,921,000	13,410,920	21,504,908
Total		140,873,968	158,461,228	171,517,816	201,199,387	207,347,404

IMPORTS.

Country.	Year beginning.	1902.	1903.	1904.	1905.	1906.
Austria-Hungary	Jan. 1	2,640,476	2,789,508	2,935,675	3,021,875	4,203,332
Belgium	do	15,908,530	16,977,346	17,983,033	18,744,212	20,813,089
Canada	July 1	2,858,778	3,213,277	2,810,238	2,490,756	[f]2,963,152
France	Jan. 1	12,061,674	12,708,795	14,611,040	19,693,018	23,053,199
Germany[d]	do	33,132,823	34,362,782	38,375,855	47,627,110	38,849,408
Italy	do	1,556,022	1,470,042	1,474,451	1,690,725	2,586,242
Netherlands	do	4,159,714	4,422,234	5,371,310	6,645,498	8,189,950
Russia	do	10,960,379	14,388,134	13,064,780	12,913,540	[f]16,684,114
United Kingdom	do	14,293,888	16,784,992	22,140,048	29,000,832	31,004,400
United States	July 1	35,010,571	59,015,551	67,234,256	57,844,345	76,963,838
Other countries		3,026,000	3,926,000	8,091,000	9,256,056	[f]9,161,152
Total		155,608,855	170,058,661	194,091,686	208,927,967	234,471,876

[a] General note.
[b] Estimated.
[c] Year preceding.
[d] Not including free ports prior to March 1, 1906.
[e] Average, 1903 and 1905.
[f] Preliminary.

The above table, taken from the Yearbook of the United States Department of Agriculture, showing the movements of rubber, is interesting, first in regard to the production of rubber and second in regard to the countries using rubber for manufacturing.

It will be noticed that Brazil produces the greatest quantity of rubber, but that the production has not increased, in uniform ratio during the years given in the table. This is also true of the other countries which export rubber in large quantities. While the general increase as shown in the totals is comparatively steady, the various countries differ considerably. A decided increase in the exports of rubber in 1903 over those of 1902 will be seen in most of the countries mentioned individually. By subtracting the exports of "other countries" for these years we find that while in 1902 the exports were 136,209,968 pounds, in 1903 they were 152,491,228 pounds. This ratio of increase is not sustained in the years 1905 and 1906, for we find that exclusive of other countries the exports in 1905 were 187,788,467 pounds and in 1906, 186,842,496 pounds. The exports from countries other than those recognized as rubber-producing have been growing rapidly, probably due to the constantly growing area cultivated for raising rubber and more modern methods of tapping. The old methods are well known to be extremely destructive, though they are still in very general use in countries where rubber is grown abundantly.

The table of imports is interesting as showing the great markets for rubber. It will be seen that the United States is far in the lead as an importer, with Germany, Belgium, the United Kingdom, France, and Russia following in order. The amount of imports increases with comparative steadiness in most cases, though Germany, in 1906, and the United States in 1905 make great drops. After 1903 other countries make no very noticeable strides, which would indicate that the manufacture of rubber products is being largely centered in certain countries. Belgium both exports and imports in very even proportion, as do also Germany, France, and the Netherlands, though Germany's imports exceed her exports. Brazil ranks easily as the greatest rubber-producing country and the United States as the greatest consumer, or more properly, the greatest rubber-manufacturing country.

THE CULTIVATION OF THEOBROMA CACAO OR COCOA.[1]

By A. FAUCHÉRE, *Assistant Inspector of Agriculture in Madagascar.*

Native habitation.—*Theobroma cacao* is an American plant. It was cultivated by the Indians along before the discovery of the New World, therefore it is difficult to determine exactly its native habitation.

It is certain, however, that the cacao tree grows wild in the basins of the Amazon and the Orinoco. But while several authors describe it as growing spontaneously in Mexico and throughout Central America, it is impossible to affirm that it grows in a truly wild state in these regions. It is probable that it has been naturalized by culture. This is the opinion of De Candole as given in "The Origin of Cultivated Plants."

It is claimed that it also grows in a wild state in the forests of Trinidad, where there are cacao trees which produce very small fruit inclosing beans that are nearly white.

Other species of the genus, *Theobroma pentagonum, Theobroma bicolor,* etc., which also furnish edible products, and are cultivated, appear to grow wild even more widely. They are found in the forests of Colombia and Central America.

These points are of secondary importance in a study which must remain essentially practical. It is sufficient to know that the theobroma furnishing the cacao of commerce grows wild in very warm and humid regions.

History.—Before the discovery of America the cacao was of course unknown in Europe. The companions of Ferdinand Cortez who landed in Mexico in 1519 were the first Europeans to use cacao. It was already in use by the natives.

It was toward the end of the sixteenth century that the cacao beans were first brought to Spain. From Spain the use of cacao spread to France, where the first chocolate seems to have been sold about 1650 by a man named Chalion, who received in this matter the special permission of the king. Later the product, at first very expensive, and much appreciated by the higher classes, became cheaper and cheaper, until now it is a delicacy within the reach of nearly all purses.

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[1] Extracts from a series of articles entitled "Culture pratique du cacaoyer" published in *L'Agriculture Pratique des Pays Chauds*, beginning in April, 1905.

The consumption increasing constantly, the area of cultivation of the cacao tree is growing more and more. This precious vegetable species is known and cultivated throughout the torrid zone in both hemispheres. However, the true center of culture for the cacao tree remains to the present time confined rather closely to those regions where the plant grew originally.

Although *Theobroma cacao* is cultivated a little everywhere in the East Indies, the west coast of Africa, and in Madagascar, the larger countries that produce cacao are South America, Central America, the Antilles, Equador, Venezuela, Trinidad, the Guianas, Brazil, and Mexico.

It is evident that many of the French colonies have a climate essentially adapted to the culture of cacao. Dahomey, the Ivory Coast, the Congo, perhaps some parts of the Senegal and the Soudan, the middle part of the east coast of Madagascar, Guiana, and the Antilles; all of these would certainly be suitable.

The culture of the cacao tree merits even more attention because it requires so little labor, and furnishes one of the rare colonial commodities whose period of overproduction appears to be far distant.

Species and varieties.—The genus Theobroma belongs to the family of the *Sterculiaceae,* division of the *Buettneriacee.* The most widely dispersed and most commonly cultivated species is the *Theobroma cacao.*

In the wild state *Theobroma cacao* is a small tree, from 7 to 8 meters high. It is generally a little shorter under cultivation, but if planted closely it reaches this height even then.

The trunk is very straight, and ordinarily terminates, when the tree is young, in a verticil of three, four, five, or six branches. Below this crown grow a large number of offshoots, much tangled, which give the young tree a very branchy and tufted appearance.

The leaves are simple, alternate, obvate, oblong, accuminated; the edge even and smooth, except upon the lower side of the veins, where it is hairy. When young the leaves are clear red or a very clear green, according to the variety; when mature they are a very fresh green on the upper side but a little less bright underneath. The dimensions of the cacao leaves vary according to the age and vigor of the tree. A plant which grows normally has leaves 25 to 30 centimeters long and 11 to 12 centimeters wide; but it is not unusual to see leaves larger than this upon young and vigorous specimens. The flowers, which appear almost throughout the year, are arranged in dichotomous cymes, and supported upon slender peduncles, usually uniflorous, and from 2 to 3 centimeters long. The flowers grow upon the old branches and the trunk, sometimes in large numbers.

The five sepals are valvular and colored, ciliated upon the edges. The five petals, alternating with the sepals are likewise colored; they have at the base an enlarged spoon-like portion, surmounted by a short part with a spatulate extremity curved toward the exterior.

The androcephalum is composed of five fertile stamens and five sterile stamens in the form of small linear tongues, which alternate with the fertile stamens. The stamens opposite the petals are terminated by a pair of another with two cells opening outward. The upper ovary, pentagonal, consists of five cells, in each of which there are at least a dozen anatropous ovules arranged in two longitudinal rows. The ovary, covered with glandular hairs, is surmounted by a style with five stigmas.

The fruit, ordinarily known as the cacao pod or capsula, is a berry with an unyielding shell, smooth or rough, of varying form and color. The pod, which is pendant, gives the trunk of the cacao a very curious appearance. Fruit and flowers may be found on the cacao-tree nearly the whole year.

When the shell of the fruit is broken, one finds in the interior the kernels, usually spoken of as beans or seeds, buried in a pink or whitish pulp, of an agreeable and slightly acid taste. The beans are composed of an embryo with wrinkled cotyledons, folded, and here are found the elements for which the cacao is cultivated. The shape of the beans varies; sometimes they are decidedly oval and very much bulged as in Madagascar cacao; again they are much flattened, and almost triangular as in Trinidad cacao. Their size also varies greatly. The beans of the Madagascar cacao are scarcely 1.5 to 2 centimeters long, while the length of those of Surinam is 2.5 centimeters and over. The envelope which surrounds the embryo is red. The color of the bean varies from almost pure white in Madagascar cacao to deep violet in the cacao of Surinam and Trinidad.

Varieties.—Cultivated from remote antiquity, *Theobroma cacao* has not failed, like all plants, to change and develop a considerable number of forms, which may almost be elevated to the rank of varieties. It is not possible, unfortunately, to credit man's will with the variations of the cacao tree; all the varieties, or to be more exact, all of the forms which now exist are nothing more than the result of chance. It is not to be doubted, however, with the tendency of the cacao tree to vary, that a consistent and intelligent selection would result in the production of varieties more profitable under cultivation than those of the present time. It would be particularly interesting to be able to develop forms that would arrive at an earlier maturity. This is the task of the Colonial experiment gardens, but it is a lengthy enterprise, demanding patience, years, and money.

In spite of all, an attempt has been made to classify the known varieties of the cacao tree. The results obtained in this arrangement have more theoretical than practical value, and doubtless each country has its special varieties. Often a form that yields mediocre products in one country, much resembles another which elsewhere furnishes a product of the finest quality.

In Trinidad the varieties of cacao are very numerous; but while the old Spanish planters arranged them in a certain number of divisions, it is very difficult to determine where one variety ends and another begins, the limits which separate them being so indefinite. The classifications of Messrs. Morris and Hart are believed to be far from having a practical value.

In the course of numerous visits among the plantations of Trinidad many of the planters were asked the names of the varieties of cacao they were cultivating; they gave very different responses to this question, two planters rarely giving the same name to an identical variety.

One variety is very well known to all the planters—that called "Calabacillo." It yields a very small fruit, which incloses flattened and serrated beans. It is a subordinate variety yet widely cultivated.

It is difficult to give an exact idea of the variety which in Trinidad is called "Criollo." No planter could point it out to me with any certainty. Hart gives to the term "Criollo" the French meaning of the words indigenous and native; indicating the same relation as when we speak of the half-breeds and blacks of Bourbon as creoles. He seems to believe that the true Criollo is a form which grows wild in the forests of Trinidad. According to him, the Criollo is a cacao tree with an elongated, pointed, slightly reddish fruit, red or yellow, with a pronounced stricture near the peduncle.

In Surinam the planters designate, under the name "Caracas cacao," all the cacaos with red fruits. But nearly all of the specimens which were shown to me for the true Caracas, a widely cultivated variety, possessed absolutely the characteristics of the Criollo described by Hart. This variety produces beautiful roundish beans, whose embryos have a violet tinge. It is the best form that exists in Guiana, and is much in demand among the planters.

The name "Forastero" in Trinidad serves to designate a number of forms inferior in quality to Criollo. The beans of these forms are rather flat, and the cup of the embryo is a deep violet.

It must be admitted that environment suffices to change the characteristics and the quality of the natural form of the cacao. Dr. Preuss offers upon this subject some valuable observations. He says in his book "The Cacao," that the Trinidad cacao introduced into Venezuela improves, and furnishes products that are superior to those which it gives in the English Colony. According to him the Guayaquil cacao, the most widely known, springs from a tree whose beans remind one of the *Amelonado* of Trinidad. The *Amelonado* is a very subordinate form in the English island.

The cacao called Surinam or "Porcelain" corresponds to the *Amelonado* of Trinidad, and is highly valued. Its fruit ripens yellow, is short, almost smooth, a little constricted at the base, and terminates in a very blunt point. It has ten longitudinal grooves more or less deep.

The Alligator cacao, *Theobroma cacao* of Guiana and *Theobroma pentagonum* of Nicaragua, is a less desirable form ripening to yellow. The shell of the fruit is very thick and wrinkled, and the beans are large but flat. The fruit is large and much elongated. Only the true Caracas produces beans whose embryo is a clear color; the other varieties have grains of deep violet color.

The varieties or forms descending from *Theobroma cacao* are far from being exactly classified. It is very difficult with our present amount of knowledge to name with certainty the kind which yields the best quality of cacao, the varieties cultivated, and the environment required for their growth. It is certain that each country possesses varieties with different qualities, and those which furnish the best products are usually the most highly cultivated.

Theobroma cacao is not the only species of the whole genus that may be cultivated to produce the cacao of commerce. In Central America there is cultivated under the name "Alligator" or "Largato," *Theobroma pentagonum,* which furnishes a product of very good cacao. This species differs little from *Theobroma cacao* except in the shape of the fruit. The fruit, instead of having grooves has five strongly marked ridges, between which there are large warts of characteristic form. The beans are large and the embryo pure white.

Theobroma augustifolium is cultivated in Mexico and Central America.

Theobroma bicolor is a large and vigorous variety, whose seeds are not exported. It is found all over Central America. Its fruit has a woody shell, and its leaves are heart-shaped. The white seeds yield a product of no commercial value, but they are much valued in America. *Theobroma bicolor* grows to a height of 12 meters and Dr. Preuss states that it is cultivated as a shade tree for *Theobroma cacao* in Nicaragua. The seeds are very poor in Theobromine.

Climate.—The fact that the natural habitation of Theobroma is never very far from the equator indicates sufficiently the climate necessities. They prosper only in very humid countries.

Under cultivation the geographical area has been much extended. The cacao may now be found as far south as the State of Bahia in Brazil, which is 19°, and Réunion, 21° south latitude, and as far north as Cuba, which is 22° north latitude. Outside of these limits the cultivation of the cacao tree is not possible except under very unusual conditions.

As a general rule the temperature necessary to the profitable growth of the cacao varies from 24° to 28°. The lowest possible temperature is 12° to 14° and the lowest temperature of the year varying from 18° to 20°. It can evidently grow and fructify in colder regions. On the Blue Mountains in Jamaica I have seen it growing and bearing beans at an altitude of 1,800 feet; but it is certain that the cacao could not be cultivated with profit in such localities.

A humid climate is absolutely essential. The cacao demands an annual rainfall of at least 1.60 to 1.80 meters, distributed throughout the entire year. An uninterrupted dry period of two or three months is very prejudicial, though this condition is now ameliorated—thanks to irrigation—and in certain districts of Nicaragua where the dry season lasts from November until May the cacao grows and bears fruit.

The necessities of the cacao with regard to humidity, and especially heat, prevent its cultivation in high altitudes. In Venezuela, Colombia, and Ceylon it is planted to an altitude of 800 meters and even a little higher, but in general its area of cultivation does not rise much above 500 meters near the equator, growing lower as the distance from the equator increases, until it is found at 100 to 150 meters at the northern and southern limits.

In fact, one may say that the regions included between the latitudes 18° south and 20° north, which enjoy climate that has little or no dry season, with an annual rainfall of 1.60 to 1.80 meters at least, and a mean temperature of from 23° to 28°, are adapted to the culture of the cacao tree. Outside of these limits it may grow, but it is rarely profitable.

Certain countries included in this zone of cultivation, which have a prolonged dry season, may grow the cacao by means of systems of irrigation which enable the soil to retain a sufficient amount of moisture.

In the following tables is indicated the rainfall of several regions where the cacao is cultivated on a large scale, and I have shown the monthly rainfall as recorded at Tamatave, Madagascar, during the year 1903. If a prolonged drouth is harmful to this industry, too much humidity may also be harmful to the production of fruit by favoring the development of the cryptogams which attack it. For instance, in Dutch Guiana after the excessive rains at the end of 1901 and early in 1902 the plantations were invaded by cryptogamic maladies, which reduced the production one-half in the best kept plantations.

Rainfall in Trinidad.

Month.	1901.	1902.
	Millimeters.	*Millimeters.*
January	86.5	43.0
February	11.4	11.3
March	94.5	59.7
April	7.5	8.8
May	162.6	108.5
June	262.1	200.5
July	253.5	133.8
August	342.5	296.0
September	128.2	97.8
October	113.5	110.5
November	136.8	125.9
December	313.9	213.1
Total	2,013.1	1,308.9

Rainfall in Tamatave.

Month.	1902.	1903.
	Millimeters.	*Millimeters.*
January	213.4	259.2
February	316.5	187.4
March	544.0	632.8
April	51.0	374.5
May	114.0	260.0
June	136.4	278.6
July	316.7	178.8
August	83.2	291.1
September	95.7	238.1
October	149.4	119.6
November	130.9	72.7
December	251.3	162.5
Total	2,402.6	3,055.3

Rainfall in Surinam.

Month.	1899.	1900.	1901.	1902.
	Millimeters.	*Millimeters.*	*Millimeters.*	*Millimeters.*
January	171.6	235.1	76.9	182.4
February	42.1	328.0	106.7	558.3
March	175.5	322.1	25.7	222.3
April	36.3	223.4	271.5	522.4
May	119.0	371.8	316.9	252.4
June	313.4	210.4	234.2	
July	144.1	87.3	179.4	
August	59.1	129.8	205.2	
September	20.5	82.6	101.1	
October	46.5	156.2	117.7	
November	64.0	134.3	203.0	
December	51.4	114.4	220.9	
Total	1,243.5	2,395.4	2,059.2	

Soil.—The cacao is rather hard to suit in the matter of soil, but nearly all the authors who have written about this plant have somewhat exaggerated its necessities. Upon reading the chapter on soil in a treatise on the culture of cacao, one is often a little dismayed and apt to question whether all the conditions enumerated could be found in several countries put together.

Having seen the industry thrive in the most diverse countries—in Brazil, in the Guianas, in Trinidad, in Guadalupe, and in Jamaica—it may be said that it is not so hard to suit as has been supposed, and that cacao is able, like all plants, to adapt itself somewhat to the environment in which it lives.

As to the physical composition of the soil, the cacao tree accommodates itself to many different kinds. It grows vigorously in the alluvial clay of Dutch Guiana, in the silicious clay of Trinidad, in the volcanic rock of Guadalupe, and it gives a product of the best quality in the alluvial soil of the Venezuelan coast, which is composed partly of earth washed down by streams from the granite and gneiss formations. In these soils resulting from the decomposition of primitive rocks the cacao seems to improve much in quality, and the Venezuelan cacaos are renowned;

those of Ceylon are likewise favorably known, and I am informed from a reliable source that those of Madagascar are considered worthy to be classed with the best.

I have observed that in the very clayey soils of Dutch Guiana the cacao tree completely transforms its radicular system; that while the taproot loses in importance, the small roots multiply considerably, and one is surprised to see the surface of the beautiful cacao plantations of Surinam covered with a veritable network of large running roots. This adaptation is all the more useful since the water table is always very near the surface. The Dutch planters multiply the drainage ditches in their plantations, but these are always necessarily shallow, for the uniformly flat country is so slightly elevated above the level of the rivers that it is necessary to preserve it from inundation at high tide by special and costly dams, in which there are sluices that drain the plantations at low tide.

As regards the chemical composition of the soil also the cacao tree demands less than has been supposed. M. Jumelle in his excellent work upon the cacao tree holds that a soil in order to be suitable for the culture of this plant should contain 1 to 2 per cent of lime and 2½ per cent of phosphoric acid. It is evident that soils well provided with potash and nitrogen which would contain these quantities of lime and phosphoric acid would offer the cacao tree large nutritive supplies, but it would be dangerous to state as a principle that soils less rich are incapable of producing cacao to a profitable extent.

However, it seems that lands which are poor in phosphoric acid and extremely poor in lime are able to produce cacao, since valuable and highly productive cacao plantations exist on the shores of the Ivoloina and the Ivondro.

MM. Muntz and Rousseaux wrote truly concerning their study of the Madagascar lands: "It is impossible to apply the same coefficient of fertility to lands having the same composition but having different climates." And again: "Some lands that are capable of producing abundant harvests in a warm and humid atmosphere would be sterile in a temperate climate."

In order to draw from the analysis of the lands exact indications as to their productivity, a scale of fertility based on a long series of analyses of lands from the same region in full bearing would be a necessary preliminary, in order to decide upon the proper method of mixture.

In a new country, how is one to determine whether or not the soil is suitable for the culture of cacao? We must reply simply that all lands having the required climatic conditions are suited to this culture if they are deep, friable, of high water-holding capacity, and if they support a forest of large and vigorous trees.

All of the planters of Trinidad, Brazil, and Dutch Guiana who have

been questioned on this subject consider this last condition the criterion, and they would not under any circumstances plant cacao upon virgin soil reclaimed merely from scanty growth or underbrush.

The presence of certain plants growing in a wild state may also be a useful indication, but they have only local value. For example, in Trinidad the best cacao lands are found in the regions where the *Oreodoxa* grow vigorously, also a special variety of Indian-shot plant, which is also found in Dutch Guiana.

Marshy lands are not adapted to the culture of cacao, nor are those where there is compact rock a little below the surface, for here the tree dies when its taproot encounters the rock. But it is, however, possible to establish a cacao plantation in rocky soil, as is often done in Trinidad.

Valleys, even when they are subject to inundations, may be planted with cacao upon condition always that the water is not allowed to remain after the inundations.

It may also be planted upon hills, even when they are very steep, but then a soil of a certain consistency is required, for if it is too mellow erosion is to be feared.

It goes without saying that in countries where the industry is established the new planter should study the conditions that have made the established plantations successful, and profit by the experiences of his predecessors.

It is strongly recomended that, before planting, numerous borings be made in the land chosen, so as not to utilize patches in which there is a bed of sand at a slight depth. In the cacao plantations visited in Madagascar, it was ascertained that the trees planted in lands that appeared to be very good upon the surface, but having a bed of sand at a slight depth, die at about six or eight years of age. The lowest parts of the valleys in Madagascar where the water stays and where the *pandanus* and the *raphia* are found, are not at all suited for cacao. The soil conditions of the cacao plantations of Brazil, in the state of Bahia, are more like those one finds in Madagascar upon the hills where the forests still exist. Soils of brick-red clay, like those of Madagascar and Brazil, lose their agricultural value shortly after the disappearance of the forest.

Clearing.—The ground being chosen, it must then be prepared and divided up. If it is covered with forests, the large trees must be felled and the larger brush cut sometime before the dry season. After this has been done and the brush is sufficiently dry, it may be burned off.

Many of the planters, more in Dutch Guiana than in Trinidad, who have been consulted on this subject were of the opinion that it would be preferable, after cutting down the forest to allow it to grow again for a number of months, and then cut all the young sprouts. Burning has the decided drawback of destroying a great quantity of organic matter, since when it is somewhat dry the humus which covers the soil in forests burns

readily. On the other hand, a large part of the ashes resulting from the burning of the trees and brush is lost for the planter, for if the land slopes a little the tiny streams will wash the ashes down to lower levels, dissolve the mineral substances they contain, and carry them to the sea. Burning, however, has the advantage of destroying a great number of insects and leaving the soil cleaner. It is also true that burning is more economical and it is the usual method of clearing.

When a forest is destroyed in order to establish a cacao plantation, there is the question of reserving near the clearing a certain number of trees to furnish shelter from the sun. The planters about Bahia do this explaining that manual laborers are scarce and they have no better shade for that region. In dutch Guiana and Trinidad the cacao planters destroy ruthlessly all the trees of a forest. They prefer to plant anew, holding it necessary that the protecting trees and the young cacaos develop together in order that the former may not harm the latter by monopolizing the soil. It is true that when the trees of the original forest are reserved for protectors their roots have a strong system already formed, and they rapidly appropriate the nourishment that is needed by the young cacao plants.

The planters of Trinidad and Surinam say that the forest trees are usually slender and have scanty tops, and consequently provide but little shade unless they are planted very near one another; and, too, the exhaustion of the soil by means of their roots is a very serious detriment to the young cacao plantation. Also when forest trees are suddenly deprived of those about them they can not offer much resistance to the wind and are easily uprooted. Naturally the harm done to the young cacaos when a tree falls among them is much greater than the expense incurred in cutting the tree down in the beginning and planting a new protector when the cacaos are first set out.

When one considers the difficulty, not to say impossibility, of saving the forest trees in regular rows and the consequent loss of regularity in the plantation, one agrees readily with the English and Dutch planters that it is much better to cut out the forest trees entirely when the clearing is done, but that sometimes it is necessary to do the other because of the scarcity of laborers or because it is hard to decide upon the kind of shade tree that would be suitable in that particular region. When the forest trees are to be saved it is necessary to clear a spare about them so that they may not be burned.

Drainage.—If the sight chosen is flat and rests upon a subsoil that is ever so slightly clayey it must be thoroughly drained by means of ditches, more or less deep and closely placed, according to the nature of the soil. In the alluvial clays of Dutch Guiana the planters have been obliged to divide their ground into strips from 7 to 8 meters wide, separated by ditches that are as much as 60 centimeters wide and not

quite so deep. These ditches empty into larger ditches, which in their turn open into the general canal that surrounds the plantation and connects with the rivers.

Where the plantation is hilly it is usually not practicable to dig ditches, but if the land slopes very much it may be necessary to make small trenches that slope gently, carrying the water off but without washing down the soil.

Shelters against the wind.—When a plantation is situated in a location that is exposed to strong winds, it is absolutely essential that every 100 meters at right angles to the direction of the prevailing winds, there should be a strip of ground at least 10 meters wide, upon which there is planted a strong barrier of trees; to prevent the roots of these trees from exhausting the surrounding land, this strip of land should be isolated from the rest of the plantation by a ditch 50 to 60 centimeters deep and equally wide.

In mountainous countries if the winds are violent, it may be prudent and even necessary to plant only upon the sides that are not exposed to the wind. If one plants upon exposed portions the shelters will have to be placed closer together, for their protection will not extend so far as it does on level ground. Of course when one plants on forest land it is wise to save these shelters at the time of cutting out the trees, and to protect them carefully while burning off the brush.

Digging up.—A thorough digging up of the soil is not usually done before planting the cacao. It would doubtless be very advantageous to have the soil well dug, as is done in Europe in the cultivation of shrubs, but unfortunately planters are limited to inefficient land labor, and are unable to give the soil the sort of culture considered indispensable in temperate climates; and they are obliged to merely work up the ground where each tree is planted. Where the soil is light and devoid of stones, even the digging of holes may be dispensed with, but since this operation is so beneficial to the young plants it should not be neglected.

Staking.—When the land has been cleared, roads planned, and the location of the wind-breaks decided upon, the planter proceeds to the staking. Staking consists in marking, with a strong stake, the exact place of each cacao tree. In Trinidad this work is usually done "by the piece," by men who are paid 4 frances for every 100 stakes planted. The making of the stakes is at their expense, though the wood used is supposed to be found on the place. When a forest is cleared all the wood that may be used for poles, stakes, etc., should be saved before the burning begins.

Alignment.—In Trinidad and Dutch Guiana it is considered very important that the lines of cacao should be very straight, and the plantations laid out with regularity. This really should be done everywhere

and in all kinds of cultivation, for it is infinitely easier to manage plantations that have been laid out carefully. In these two countries all the work of keeping the plantations in repair is done "by the job," and it is indispensable that they be regular. In the matter of weeding, for instance, the price is based on the surface covered by a given number of trees. Regularity in a plantation has the further advantage of giving all the trees the same amount of space, and allowing each one an equal chance to develop.

Distance.—The distance at which trees are planted varies necessarily with the richness of the soil, but ordinarily they are planted much too close. In Surinam, in the old plantations, the trees are 14 feet apart, but the planters have concluded that this distance is not sufficient and they now plant at 16 and 18 feet.

If it is desired to cultivate the soil intensively, the method adopted by Grenada planters may be followed, and the cacaos placed 3 meters apart without shelter from the sun. The period of full bearing comes more quickly, but the plantation does not last so long and it is necessary, in order to maintain the productivity, to provide dressing for the soil, as well as to burn it, measures not usually necessary in large plantations.

If too close planting has its drawbacks, too great spacing is equally bad, because the trees consume too much time in covering the soil with their shade, the expenses of keeping a plantation in repair are increased also, for when the soil is entirely shaded the undergrowth is scantier, and the expenses of weeding are reduced to a minimum. It must also be considered that in plantations very widely spaced the period of full bearing is attained later, but the returns are greater than in closer spaced plantations.

The manager of the Jagshust plantation, one of the largest and most intelligently conducted in Dutch Guiana, stated last year that it seemed very practical to him to plant the cacaos in rows 3 meters apart and the trees placed from 5.5 to 6 meters apart in the rows, in such a way that the trees on one line alternate in position with those on the adjacent lines. This method of procedure avoids both extremes and has added value because it comes from a person who is very well posted on all that concerns the practical culture of cacao.

Shelter from the sun.—The staking being completed, the shade trees are to be planted. Of course the wind-breaks should be planted as far in advance as possible, but it is well not to plant the shade trees too long before the cacaos to avoid the afore-mentioned difficulty of having the shade trees so well developed that they monopolize the soil before the cacaos are planted.

All of the planters consulted on the subject agreed that it is bad to plant under too dense a shade. The young trees remain puny and weak,

while if they are exposed somewhat to the sun during the first few years they are much stronger.

Character of the wind-breaks.—The wind-breaks are, as we have said, belts of trees planted certain distances apart, at right angles to the prevailing winds, to protect the plantations from their ravages.

The wind-break should be a veritable curtain which should be formed:

First, of a row of large trees planted in the center.

Second, of rows of small trees or shrubs which will fill in around the bare trunks and lower branches of the larger trees.

One should proceed thus: Plant in the center of the strip of land, upon two lines 2 meters apart, the large trees 4 meters apart on the line. On each side there should remain a space 4 meters wide, in which plant two or three rows of little trees or shrubs.

The essential requirements in choosing trees for wind-breaks are that they should grow rapidly and be flexible enough not to break in a strong wind. A large number of species meet these requirements more or less perfectly. These varieties are, for the large trees: *Artocarpus incisa* and *integrifolia, Swietenia mahagoni* and *macrophylla, Cedrela odorata, Hura crepitans,* several *Ficus, Eucalyptus robusta* and *citriodora, Grevillea robusta,* etc., *Albizzia stipulata, Inga dulcis, Khaya senegalensis, Melin Azedarack,* etc.[1]

As for the smaller plants, about 2 meters high, which must be bushy from the base, there is only the difficulty of choosing among a great number. The *Acalypha,* which grows very rapidly, attains a height of 5 or 6 meters, and grows easily from slips, all of which qualities render it very suitable for this purpose. As we said above, it will be well to establish the wind-breaks as long as possible before setting out the plantation, but if this can not be very long it would be prudent to plant, in places that are least protected, temporary shelters of banana trees.

Planting of trees for shade.—Nearly all planters admit that shade is absolutely indispensable to the cacao tree. Examination of the localities in which the cacao grows naturally supports this view, but nevertheless while it is recognized that shade is indispensable when the tree is young, I can not say that the same is true after a certain age is reached. The various methods of cultivation that are used prevent the making of a definite statement in this regard, for while certain planters like those of Trinidad are of the opinion that compact shade is absolutely necessary, others believe that this is not so. In Dutch Guiana it is agreed that in the past the plantations have been too much shaded, so where the

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[1] The *Artocarpus incisa* and *integrifolia, Swietenia mahagoni* and *macrophylla, Ficus* and *Eucalyptus* grow in the Philippines. The Madre-cacao, *cacuarina equisetafolia, Tamarindue indices,* and *Acacia melanoxylon,* native trees, are also recommended.

shade trees were formerly spaced at 30 feet, in the new plantations they are 60 and 66 feet apart; and in one of the districts of Dutch Guiana there is a 200-acre plantation with no shade trees whatever, which yields very satisfactory results. In Grenada, situated very near to Trinidad, the cacaos are not shaded at all. I should not conclude that those who shade the cacaos are wrong, and those who do not shade them are right, or vice versa. In agriculture it is necessary to be very prudent before condemning this or that method of cultivation, for it is usually based on practical observations, confirmed by many years of experience. I will say on the contrary, that it seems to me that the Trinidad planters who shade their cacaos excessively are right, and that those of Grenada, who do not shade them, are equally right, since both succeed in making money.

It is necessary, I think, to search out the cause of the differences in these methods of cultivation, and Dr. Preuss believes that it lies in climatic differences, also possibly in different soil conditions. While in Trinidad the annual rainfall rarely execeeds 1.8 meters, in Grenada it is almost never less than 3 meters. The planters of Trinidad have often remarked that in dry years the plantations insufficiently shaded are destroyed, and on the contrary, those in which the shade trees were well-developed resisted the drought sucessfully. In Trinidad one shade tree is planted for two cacaos. This gives much shade. But in Nicaragua, where the dry season lasts a long time, frequently a shade tree is planted for each cacao.

In short, observation of existing facts leads to the general conclusion that intensity of foliage, all other things being equal, varies inversely as the degree of the humidity of the climate; and under certain circumstances the shade trees may even be entirely dispensed with. Cacaos raised under these conditions are not so well developed, bear fruit much sooner, and wear out more rapidly.

The climate of the east coast of Madagascar, if one considers only the amount of rain, is on the whole very humid, since the annual rainfall is often as much as three meters. It must be considered that the climate in general, probably on account of the complete absence of forests, on the greater part of the shore is decidedly different from that of other more heavily wooded regions, Trinidad for example, where the rainfall is much less.

In forest regions few days pass in which there are not drizzling rains, which, it is true, leave slight traces in the rain gauge, but are sufficient to maintain the freshness and considerably diminish the evaporation. Upon the east coast of Madagascar, on the contrary, in the height of the rainy season, there are many successive days without even slight precipitation. These dry periods, which almost immediately follow the very rainy periods, are generally accompanied by continued sunshine

and dry winds and before long the plants suffer from too much evaporation.

These observations lead me to believe, though other persons are of the opposite opinion, that the cacao has absolute need of fairly intense shade, at least in the region about Tamatave.

Other statements in this connection suggest that the failures which have accompanied certain attempts at cultivation of the cacao upon the east coast are partly due to insufficient shade and shelter against the wind.

Temporary shelters.—The temporary shelters must, of course, grow rapidly to adequately shade the young plantation. The banana is usually chosen, but the planters of Trinidad, Venezuela, and Guiana ordinarily add at first, to augment the shade, certain other species such as cassava, which they plant very close to the young cacao.

In many places one banana is planted for each cacao, in Trinidad two are planted. In Surinam I have seen young cacao plantations in which the trees were planted 16 feet apart, while the distance between the bananas is 10 feet. This makes the plantation irregular, which I do not recommend, and I much prefer the method employed in Trinidad. The stakes marking the places of the cacaos having been planted in squares, 4 or 4.5 meters apart, the places of the bananas are next marked with smaller pickets. The cacaos are planted upon the lines, and in each direction a banana is placed halfway between one cacao and the next. Thus there are two bananas for each cacao. This arrangement I consider preferable to that in which the cacaos are planted between continuous lines of bananas, for these lines soon form a sort of canopy and so place the cacaos in a passage that deprives them of light and subjects them to a continual current of air. One may, of course, plant in squares, or quincunx (the trees in one row opposite the spaces in the next row). In the latter arrangement the trees are more evenly spaced.

In Jamaica the cacao is often planted in banana plantations, whose fruit is shipped to the United States.

In Dutch Guiana, as generally in Trinidad, this or that species of banana is not employed indifferently, but the preference is given to the *Musa paradisiaca,* which the Dutch call "Bakoven" and the English "Plantin." In Trinidad the variety of banana chiefly cultivated is the "Gross-Michel," which must also be a variety of *Musa paradisiaca.*

The forms of *Musa sapientum* give less shade, develop less, and ordinarily finish by fruiting in the third year.

Among the varieties of the banana studied at the Ivoloina experiment station to determine their value as shade plants in the cacao plantations, one, the "Banana figue," known to the natives as "Ankondromvazaha" (banana in English), has suffered so much from the attacks of a

weevil, recognized by M. Fleutiaux, entomologist of the Colonial garden, as *Sphenophorus sordidus*, that it has been completed destroyed, leaving the young cacaos which it was shading exposed to the rays of the sun. This circumstance confirms the statement that in Madagascar as everywhere else the cacao needs a great deal of shade when young. The abaca will, perhaps, be found useful, the fibers of which find ready sale in Europe.

At the same time or a little after the bananas are planted, it is customary to plant three slips of cassava, in triangular position about 60 centimeters from the stake that marks the place for each cacao. These will furnish shade for the young plant in the first days after setting out, or if the seed is planted directly in the ground, when it first sprouts.

Other plants may be used in place of the cassava; but they must be plants that grow quickly and start easily from slips. The "pignon d'Inde," used as a support for vanilla, might be used as a substitute. The mulberry tree is another possible substitute, and the Ambrevade (*Cajanus indica*) or the mimosa of La Réunion (*Leucaeña glauca*) might also be employed.

At the Ivoloina experiment station important experiments in connection with shade trees are soon to be commenced. The *Cajanus indica, Lancaena glauca,* and the Murier already in use by a planter in the Ivondro valley, are to be the subjects. The first two varieties, which are leguminous plants, grow rapidly, are very jagged in shape, possess the ability to absorb nitrogen from the air, and are valuable for fodder. They seem to be even better than cassava for shielding the young cacaos. It suffices, apparently, to sow their seeds about three months before the cacao trees are set out, in three or four places around the holes that the young trees are to occupy, in order to secure the proper amount of shade.

In South America and the Antilles the cassava is given the preference because its product is valuable. When it is a question of replacing a plantation of shrubs already established, with cacao, it is often possible to make use of the shrubs already planted, for temporary shelter. Thus in Dutch Guiana I have seen planters use coffee trees to shade the young cacaos that were to replace them in the course of time. When this is done it is necessary to carefully prune and thin the shrubs so that the young plants about them will not suffer.

Permanent shelters.—Permanent shelters are made of various kinds of trees which should theoretically fulfill the following conditions: They should grow rapidly, should have taproots, in order not to exhaust the surface of the soil, should grow high enough so that the cacaos can attain full development beneath their tops, and should have foliage dense enough to afford sufficient but not too much shade.

As a matter of fact it is almost impossible to find a tree that combines all the requisites I have enumerated, though most of the trees employed by the planters in the different countries possess them to a greater or less extent.

The trees most in use for shading cacao plantations are probably those which belong to the genus Erythrina. In Dutch Guiana, Trinidad, and Venezuela they plant almost exclusively *Erythrina umbrosa* and *velutina,* which the old Spanish planters called "Madre del cacao" (mother of cacao), and the Dutch of Surinam "Koffèemama." The *Erythrina umbrosa,* known in Trinidad under the name of "Ananco," is tall, of large dimensions, and reserved for mountainous regions. *Erythrina velutina,* called "Bocare," is especially suited to the plains, and thrives more than *Erythrina umbrosa* in humid ground. This is certainly the "Bocare" found everywhere in Dutch Guiana.

The Dutch, the English of Trinidad, and Venezuelan planters would not consider replacing the Erythrina with any other vegetable species. One would suppose that this tree possessed all the requisite qualities given above, but this is not the case. In the first place the Erythrina have thick trunks, and *Erythrina umbrosa* in plantations often attain a height of more than 25 meters, their trunks being more than a meter thick at the base. Multiplying by means of slips or suckers, these gigantic trees have no taproot. Their radicular system is uniquely formed of enormous roots which run on top of the soil more than 20 meters from the trunk, not always rendering the tree sufficiently stable, especially when it grows on clayey slopes. In the cacao-plantations in the districts of Montserrat and Couva I have more than once seen these giants uprooted by the wind, usually after a heavy rain. The damage done, by their fall, to the cacao trees in the immediate vicinity can easily be imagined. This is not the only drawback possessed by these "immortals." They drop their leaves each year. Some persons regard this as an advantage, but all the planters questioned considered it a disadvantage; and Dr. Preuss, whose judgment is indisputable in matters of colonial cultures, is also of their opinion.

In view of these drawbacks one naturally questions why planters as expert in cacao culture as those of the Guianas, Trinidad, and Venezuela persist in using such a species. It has, in common with all leguminous plants, the ability to assimilate directly, through symbiosis, atmospheric nitrogen, but this fact is not sufficient to explain the preference of the planters.

Recently Professor Carmady, government chemist in Trinidad, in the course of a very interesting study has demonstrated scientifically the reason for the almost exclusive use of the Erythrina in that island for shading the cacao plantations.

Bonane's experiments have shown us that cacao beans are very rich in nitrogen, and he has calculated that 1,000 kilos of cured beans contain 16.4 kilos of nitrogen. Thus, with every ton of cured cacao exported from a plantation the soil loses 10.4 kilos of nitrogen, which can only be replaced by the nitrification of organic material that is already present, unless it is artificially introduced in manure or by some other means.

M. Carmady has demonstrated in a series of analyses that Erythrina have such great power to assimilate nitrogen that the flowers which fall to the ground furnish sufficient nitrogen to make up for that loss through the cacao beans. He has calculated that 250 cacao trees produced 500 pounds of cacao, containing altogether 12.5 pounds of nitrogen. To shade these cacao trees 50 "immortals" are required, which drop about 500 pounds of dry flowers containing 4 per cent of nitrogen—about 20 pounds.

This author has also remarked that the flowers should be turned under the surface as soon as possible after they have fallen, for they rapidly lose a large part of their nitrogen. This fact has been ascertained through analyses made in the laboratory at Port of Spain. The fresh Erythrina flowers contain but 6.32 per cent, of nitrogen. Two days after their fall they contain but 5.16 per cent, and five days after they contain 4.25 per cent.

The quantity 500 pounds, which M. Carmady indicates as the production of 50 trees, will not seem to be an exaggeration to anyone who has seen this species when it is in flower. It very evidently belongs to those arborescent species which flower most abundantly.

The Java planters make use of many species of Erythrina, among them *Erythrina subombrans*. The ability to assimilate nitrogen possessed by this plant species has been demonstrated by M. Grandeau, who has, according to M. Dybowski, given the following analysis of 1,000 kilos of dry leaves:

	Kilos.
Nitrogen	18.79
Phosphoric acid	1.40
Potash	3.18
Lime	37.00
Magnesia	2.50

It is quite evident that the fallen leaves amount to a veritable dressing for the soil.

Beside the desirable qualities pointed out by M. M. Carmady and Grandeau, the Erythrina have the further advantages of growing rapidly and multiplying readily by slips. In three or four years they are high enough to shade the cacaos. However, it is unfortunate that its wood is of no value.

In Nicaragua the *Gliceridium maculata* is used. I have seen this species under experiment at the Sainte-Clair station, in Trinidad, and the director expressed strong hopes of success.

The *Pithcolobium saman,* which is sometimes employed in Venezuela, is not used at all in Trinidad or Dutch Guiana, where it is considered worthless because its development is slow and nothing can grow under its shade. M. Hart, of Trinidad, however, who is a man of very wide experience, recommends the use of this tree.

In the East Indies different species of Albizzia are used, particularly *Albizzia moluccana* and *stipulata,* which grow with extraordinary rapidity, but which are said to offer too little resistance to the winds. *Albizzia lebbeck* is also employed. It grows more slowly, but resists storms more successfuly.

Many other species are considered valuable; among them the *Swietenia mahagoni.* In Guadaloupe the *Cedrela odorata* are preferred to the Erythrina, which are said to be overrun by parasites. This argument does seem convincing to me, for in Dutch Guiana the planters take care, every other year, to clear the "immortals" of the multitudes of epiphytes that cover them. The *Cedrela odorata* and the *Swietenia mahagoni* are trees that attain gigantic dimensions, and give, it is true, after thirty or forty years, wood of good quality, but they have not the ability that leguminous plants possess to assimilate atmospheric nitrogen, and so they exhaust the soil to a considerable extent. For this reason I do not agree with Guerin who values them highly. The cacao plantation sheltered by *Cedrela* and *Khaya senegalensis* which I visited in Guadaloupe are not to be compared with those of Trinidad.

Of the many other species used to shade cacao plantations, *Autocarpus incisa,* different species of Inga, the Anacardium, *Hura crepitans,* and in Ceylon, the *Manihot glaziovii,* none except the Inga, give the best results. They are not employed to any great extent, except those which bear edible fruits, for the planters who possess but little ground plant a mixture of all species that will furnish food products. The *Manihot glaziovii* is utterly useless in Madagascar, where it is easily broken by the cyclones. In Jamaica I have seen a small cacao plantation shaded by coconut palms, but I do not believe that the coconut palm could be regularly cited as a shade tree for cacao plantations.

Some authors have written that the nutmeg tree is used in certain places, but this must have been an error, for the growth of *Myristica fragans* is much too slow, and this plant is supposed to require shelter itself during the first years of its life.

On the whole, in choosing the species for permanent shade trees, it seems best to confine oneself to trees of the leguminous variety, which grow rapidly and least exhaust the soil. Small planters employ all sorts

of varieties mixed together, but I do not consider this advisable. For the Congo, M. Rousselot recommends the *Musanga sclinithi,* much valued by M. Dybowski.

In Madagascar, the plantations established up to the present on the east coast are all shaded with "bois-noir" (*Albizzia lebbeck*), which develops very satisfactorily. It grows slowly, unfortunately, but it resists the wind very well, and is, so far, the only species that has shown good cause for being recommended. The foliage is not too dense, in fact this is the chief drawback, for it is deciduous, and is said to leave the trees it should shade too long exposed to the sun.

Multiplication of this species may be by means of slips, but the seeds are generally used, since the young plants stand transplanting well. The growth is less rapid than that of Erythrina, so it is necessary to plant *Albizzia lebbeck* at least two years before setting out the young cacao trees. In every case I recommended that colonists delay planting the bananas until after the Albizzia have attained a certain height, because if the bananas get the upper hand, they will form too intense a shade and may prevent their growth. The observations made at the Ivoloina station are quite convincing in this matter.

On the east coast of Madagascar there are many species of "immortals" of which we do not know the exact names. It is very probable that they can be utilized as well as the *Erythrina umbrosa* and *velutina.* It is a pity that their foliage does not last long and is attacked at different times of the year by a multitude of caterpillars which may be very dangerous for the cacao plantation. Nevertheless, I believe as did the late M. Lacharme, that it would be interesting to study these species with a view of determining their value as shade trees.

In the Matitanana valley, Province of Farafangana, there are a great number of Erythrina which are well developed and strongly resemble the "Bocare" of Trinidad. The natives call this "Sanganakoholahy" (cock's comb), and are well aware of the favorable influence it exerts in cultivation generally. They are very glad to plant their rice where it has been growing. It is probable that this species might be advantageously employed to shade cacao plantations.

Albizzia lebbeck, though it has valuable qualities, is not altogether suitable because it grows slowly and has deciduous foliage. Since 1898 the Department of Agriculture has been introducing into Madagascar the species most used by the planters of the East Indies. *Albizzia maluccana, Albizzia stipulata,* and *Pithecolobium saman* are now being studied at the Tamatave station. The first two species grow with extraordinary rapidity. Plants set in place in August, 1901, were over 7 meters high in February, 1902.

So far as we can now tell, these two varieties, which seem to resist the wind very well at the Ivoloina experiment station, may be employed on the east coast with very satisfactory results. It suffices, apparently, to plant them several months before the bananas, so that they will not suffer from too intense shade, and if set out at least six or eight months before the young cacaos, they should be ready to shade the plantation when the bananas begin to lose their vigor. They are covered with leaves during the entire year, which is also a desirable characteristic. These experiments are of too recent date to enable us to draw very perfect conclusions. It will be necessary first to see how practical they prove as shade trees on plantations, before stating their exact value, but it appears that they can be tried without any fear of bad results.

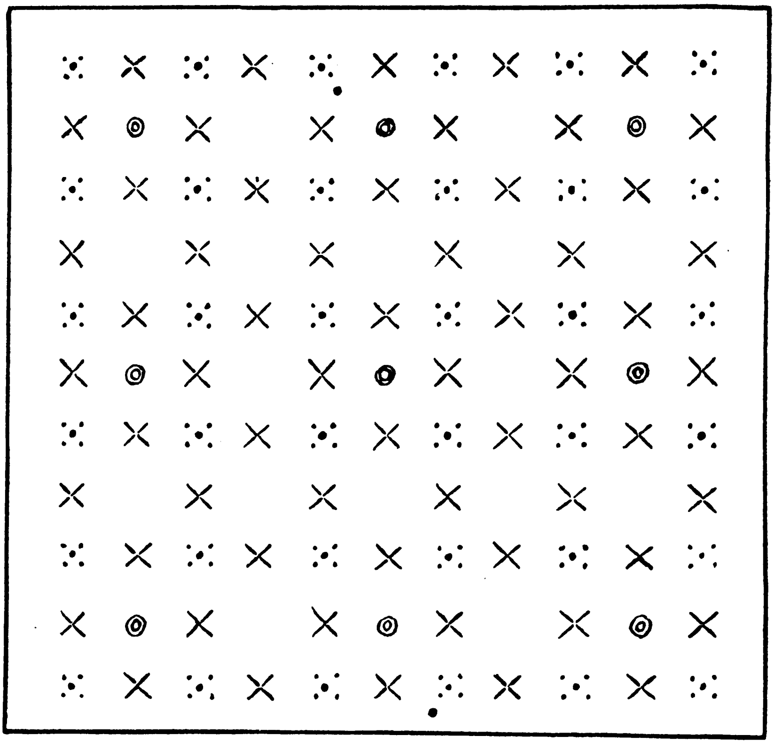
The *Pitchecolobium saman* develops very slowly. Those planted at the same time as the *Albizzia moluccana* and *stipulata* have attained a height of only 2.5 meters. They grow very capriciously, but appear to offer strong resistance to the wind. We shall know in the future the shade value of this plant in Madagascar.

Spacing of shade trees.—The trees intended for permanent shade should, as we have said before, be planted rather widely apart when the plantation is situated in a humid region. In Dutch Guiana the "immortals" were formerly planted 30 feet (10 meters) apart, but now the distance has been increased to 60 and 66 feet (20 to 22 meters). In Trinidad, on the contrary they are much closer, and the distance ordinarily adopted is 28 feet (about 9 meters), or double the distance that separates the cacaos.

In dryer regions, such as Nicaragua, one shade tree is often planted for each cacao. In Madagascar, considering the climate, and the development attained by the "bois noir," and as nearly as we can judge by the *Albizzia moluccana* and *stipulata,* it would seem best to plant 8 or 9 meters apart, according to whether the planting is done in squares or quincunx, in order to assure sufficient shade in the first years after the bananas are taken out. Later it will probably be necessary to take out every second tree, but this elimination must be done gradually, and preceded by judicious prunning.

To avoid possible damage to the cacaos through the felling of large trees, Trinidad planters cut a ring from 50 to 60 centimeters wide around the base of the tree that is to be cut down, and strip off the bark. The tree dries up slowly, decay sets in and the big branches fall one by one.

To conclude the discussion of the arrangement of a plantation, I have made this sketch (see diagram), in which the cacaos are supposed to be planted 4 meters apart, the shade trees 8 meters, and the bananas 4 meters on lines 2 meters apart.



◎ ERYTHRINE | ⁘ SLIPS OF CASSAVA, ETC., FOR TEMPORARY SHELTERS
• CACAO TREES
X BANANA TREES

This is the arrangement adopted by the Trinidad planters, who have just claim to the reputation of knowing how to cultivate cacao.

Holing.—As a general rule it is admitted that the holes should be dug as long as possible before the planting. In countries favorable to cacao culture this may be done if the soil is permeable. If it is clayey, as in Dutch Guiana, it is preferable to fill the holes up again after they have been dug, otherwise they will become full of water and it will be necessary to empty this before the plant is set in place. Besides being unnecessary this process would leave the hole in poor condition for the planting.

In Madagascar there is but little inconvenience of this sort to contend with. The alluvial soil is usually quite permeable, and the water that collects in the holes after continued rains soon soaks into the surrounding earth.

The size of the holes varies according to the soil. In regions where the ground is mellow and hand labor scarce, as in Equador for instance,

holes are not usually dug. In Trinidad, however, where the soil is very compact, they are also dispensed with, and at the time the plant with the ball of earth about its roots is set in place, it is sufficient to make a hole a very little larger than this ball, and set the tree in it. It would be better, perhaps, to dig holes, but the results justify the means. Cacao plantations in Trinidad planted in this manner grew well, and that is enough for the planters who obtain profitable results.

Surinam planters usually dig holes because of the compactness of the soil. These excavations measure 3 feet (1 meter) on each side, and are 1½ feet (0.5 of a meter) deep. It might be well to make them a little deeper, for in Surinam, as has been said before, the cacao sends out a large number of horizontal roots which spread out over the surface of the ground, and which do not always give the tree sufficient stability, so that it is often uprooted by the wind. By digging deeper the taproot is enabled to push farther down and thus render the tree more stable. However, the peculiar condition of the soil at Surinam must be considered, for there the water table lies so near the surface that the taproot should not be allowed to penetrate so far as it might in more healthy soils.

On the east coast of Madagascar the holes measure 60 centimeters on each side, which appears to be sufficient. When the holes have been filled up and are emptied again for planting, settling must be allowed for. In replacing the earth a mound at least 8 or 10 centimeters above the level of the ground should be formed, so that after the earth has settled the collar of the tree will be on a level with the mound. Otherwise the cacao is soon surrounded by a sort of basin, in which the water collects after each rain, to the great detriment of the radicular system.

When the plantation is made in a forest clearing, which means that the ground will be covered with a more are less thick bed of humus, it would be a mistake to fill up the holes with pure humus.

This humus is so diluted by the rains and becomes so hot under the rays of the sun that plants so placed can not live, or at least can not thrive. Experiments made in this line in Dutch Guiana by M. Folmer, manager of Jagltust, the most important plantation in Surinam, have been absolutely conclusive, and it has been found necessary in filling up the holes to mix the humus and the earth in more or less equal parts.

In Madagascar the surface of the land suitable for cacao culture is covered with a layer formed of vegetable mold, with which one need not fear to fill the holes. In filling the holes it may be useful, when the soil is not very rich, to put in some ashes and manure. The Dutch planters do this when they plant upon land that has already produced a crop, for example, of sugar cane.

Holes for the shade trees are not usually dug in advance. It is customary to dig them when the trees are ready to be placed, and they are as small as possible.

A STUDY OF THE VARIETIES OF ABACA (MANILA HEMP).[1]

By M. M. Saleeby, B. S.

INTRODUCTION.

In the abacá industry, as well as in the industry of any other fiber plant, five steps present themselves to the progressive planter. They are: (1) The selection of a suitable location; (2) the mode of preparing the soil; (3) the selection of seeds; (4) cultivation; and (5) the extraction of fiber.

Many reliable publications issued by the Bureau of Agriculture safely guide the planter through all the above-mentioned steps, with the exception of the third, regarding which, as far as I have seen, no information of any weight has been offered him. This step is no more an insignificant one, since it has been demonstrated that there are many varieties of abacá differing considerably in the quality and relative quantity of the fiber contained therein, as well as in size and extent of growth. Indeed the difference in the net results amounts to as much as 30 per cent, or even more, as will be shown later on; besides some varieties are of so much hardier growth than others that where they thrive fairly well the others fail altogether.

Such being the magnitude of this step in the abacá industry, it would be an unpardonable shame if the industry were allowed to continue any longer destitute of one of the principal constituents that is essential to its success.

To do justice to this step, then, demands a thorough study of the common varieties under cultivation with the aim of facilitating their identification and finding out which of them possess all or most of the desirable qualities, which may be summed up in rapid and hardy growth, great size, abundant fiber of good quality and easy of extraction. All varieties fulfilling most of the above requisites will be suitable for propagation.

This study is obviously full of difficulties and of a complex nature which I do not profess to have as yet overcome completely or to have arrived at a perfect and ultimate result, but I hope, with the conclusions reached, to be able to give the prospective planter some helpful suggestions that may safely guide him toward success.

[1] Published in *The Mindanao Herald*, volume 6, No. 11, Feb. 3, 1909.

CLASSIFICATION.

In the district of Davao there are nine varieties of abacá under cultivation, namely: (1) Tangouan, (2) Maguindanao, (3) Bangulanun, (4) Libuton, (5) Arupan, (6) Lumawaan, (7) Puteean, (8) Baguisanun, and (9) Agutay. The first six are the principal ones, while the last three are the ones that should be carefully avoided for reasons hereafter given.

The principal differences between these varieties are in the color, the size and shape of the stalk, the tendency to produce suckers, and the quality and quantity of the fiber. The color of the flower cone is not a very safe guide, excepting in the Libuton variety where a marked difference in the color can be easily detected; the way the leaves emanate from the stalk will be referred to occasionally where that helps as a distinguishing characteristic.

1. TANGOUAN.

This variety is undoubtedly the hardiest. It is not a rare sight to see the Tangouan growing to a good size in an indifferent soil with little attention, where other varieties are making a desperate struggle for existence. The difficult processes of tuxy-making and of stripping this variety also show its hardy nature.

Color of stalk.—The color of the Tangouan stalk is both light and deep purple with hardly any green lines running up and down as in the other varieties. Often the color on the outward side of the stalk is deeper, almost approaching black. In other words, the dark and glossy aspect of the Tangouan hill is peculiar, and no other variety can be mistaken for it.

Size of stalk.—The stalks may grow to a great height and size, especially in what the natives call the "Male Tangouan." On many occasions I have handled stalks measuring 20 feet in height and weighing 200 to 220 pounds, while in one instance I stripped 6 pounds of dry fiber from one stalk with the ordinary method of stripping.

Shape of stalk.—The stalk tapers as in most other varieties; the ratio between the circumference at the top and that at the base being as $2\frac{1}{5}$ to 1.

Tendency to produce suckers.—The male variety that has been mentioned before as bearing large stalks does not produce as many suckers as the female variety, the stalks of which do not come to any considerable height or size. In other respects the two behave exactly the same.

Quality of fiber.—The fiber is coarser and stronger but not quite so white as that of the others. That it is the strongest fiber, I have no doubt; but as to its coarseness and brownness, it may be all or partly owing to imperfect stripping; to strip this variety for any considerable length of time is a trying task that most strippers are averse to tackling.

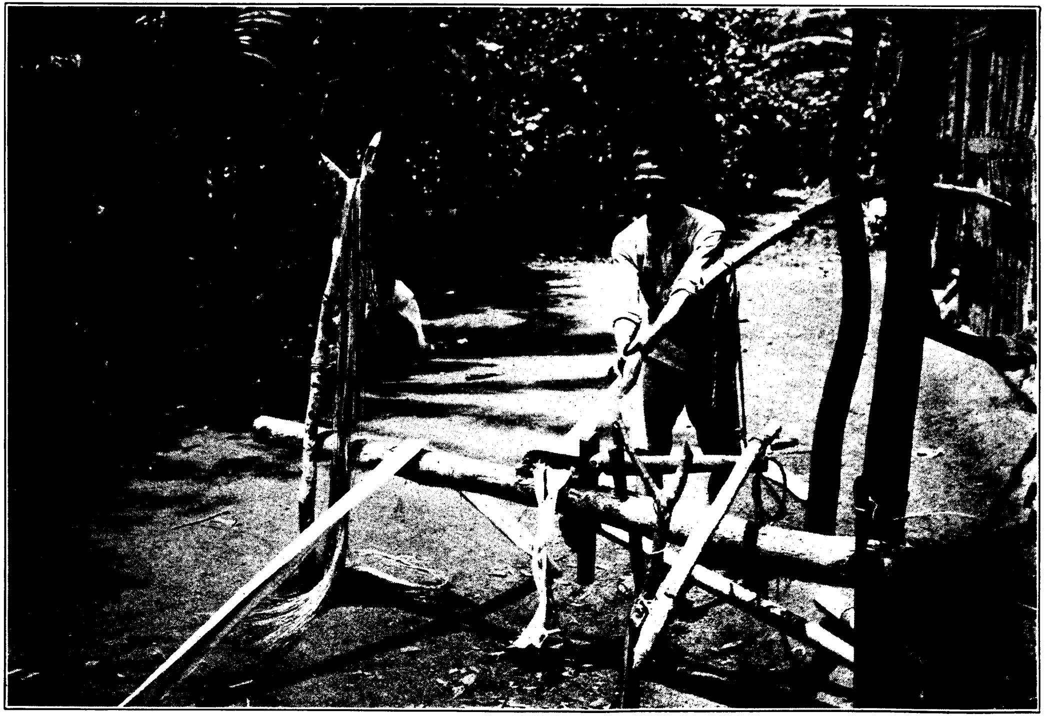


PLATE II. NATIVE METHOD OF STRIPPING MANILA HEMP.

Quantity of fiber.—Every 100 pounds of stalk material contain from $2\frac{1}{2}$ to $2\frac{3}{4}$ pounds of dry fiber.

2. MAGUINDANAO.

This is the favorite variety of a large number of planters, because of the good quality of its fiber and the facility of extracting it. It is also reckoned among the hardy varieties, though it falls short of Tangouan in this respect.

The way the leaves hang on the step is different from any other variety. After reaching a certain height, or as soon as they come out of the stalk, they bend down and take the shape of a bow.

Color of stalk.—More or less green with light purple and brown colors running through it.

Size of stalk.—Generally speaking it grows to a greater size than Tangouan, especially at the base, but it does not grow so high.

Shape of stalk.—Even a little more tapering than Tangouan, the ratio between the two circumferences being as $2\frac{1}{3}$ to 1.

Tendency to produce suckers.—As a rule it produces more stalks to the hill than Tangouan, 15 to 20 being about an average.

Quality of fiber.—White, strong and easy of extraction.

Quantity of fiber.—About $1\frac{3}{4}$ pounds to every 100 pounds of stalk material.

3. BANGULANUN.

Lately this variety has been gaining favor with many planters and is preferred by them to both Tangouan and Maguindanao. We have not this variety on our place, and unfortunately I have not had time to study it carefully, but from the reports about it, it seems to possess all of the requisites of an abacá plant, with the exception of the size of the stalks which do not grow to any considerable height or size. It has a good number of stalks to the hill, and a white and abundant fiber.

4. LIBUTON.

Color of stalk.—It is a mixture of deep green and brown, the light purple colors of the first two being absent here.

Shape of stalk.—Just like Tangouan.

Size of stalk.—The stalks do not grow to the size of Maguindanao or Tangouan, while a height of 15 feet is about all they can reach.

Color of flower cone.—The color of the bracts subtending the blossoms is almost all green with slight brown hues on the sides and top of each bract. It is therefore the easiest variety to distinguish when in a ripe condition.

Tendency to produce suckers.—I can safely say that it produces more stalks to the hill than either Maguindanao or Tangouan; the hill seems

to possess a round appearance due to the regularity of the root stock in sending out its suckers.

Quality of fiber.—If any difference exists between it and Maguindanao, one can not detect it with the naked eye. It is also about as easy to strip.

Quantity of fiber.—It is a shade less than in Maguindanao, 100 pounds of stalk contain about $1\frac{1}{3}$ to $1\frac{1}{2}$ pounds of dry fiber.

5. ARUPAN.

In general outward appearance this variety is very similar to Maguindanao and to most of the varieties to be described below, hence very few planters know of it or have even heard of it; it is very extensively grown, especially in the neighborhood of Davao.

That there is such a variety, can be easily shown by three particular characteristics, which can not be shown in any other. These are the comparative shortness of the stalk, the comparative thickness at the top, and the redish color of the tuxy ten minutes after it is separated. This latter, in my opinion, is due to an excess of tannic acid, or to stronger acid than that found in other varieties.

Color of stalk.—Differing from Maguindanao in having more of green and less of shining color; it is also noted that the green is somewhat lighter than that found in Maguindanao.

Size of stalk.—It never grows to any considerable height, but in thickness the stalk does not fall far short of either Tangouan or Maguindanao.

Shape of stalk.—The least tapering of all varieties, the ratio between the two circumferences not exceeding $1\frac{3}{4}$ to 1.

Tendency to produce suckers.—In this respect it may be put down as equal to Maguindanao.

Quality of fiber.—Somewhat hard to strip, and dull in color, though not to the extent of Tangouan.

Quantity of fiber.—About the same, if not a little greater than in Maguindanao. From $1\frac{1}{2}$ to $1\frac{3}{4}$ pounds of dry fiber can be obtained from 100 pounds of stalk material.

6. LUMAWAAN.

We have only a few hills of this variety on our place, and at the time of preparing this paper none of these stalks are mature. Judging from experiments on immature stalks, I find that it contains as much fiber as either Arupan or Maguindanao, but of better quality than either of them. In general appearance it looks very much like Maguindanao, excepting in the leaves which shoot straight up as in most other varieties. It grows to a good height and size but does not send out many suckers. In my opinion, it is the plant called "Female Baguisanun" on the east side of the Gulf of Davao.

7. PUTEEAN.

A very bad reputation has attached itself to this variety, probably on account of its weakness of growth. It seems to grow well only on soft loams alongside a river or stream whose water occasionally overflows and leaves a rich deposit. In other places where the soil is somewhat harder and drier it fails altogether and hardly comes to anything worth caring for.

Color of stalk.—Somewhat darker and less shining than the Maguindanao.

Size of stalk.—At its best it never grows higher than 13 or 14 feet, while in thickness it can be safely said that it is the smallest, with the exception of agutay.

Shape of stalk.—The ratio between the two circumstances is as 2 to 1.

Tendency to produce suckers.—Somewhat less than in Arupan or Maguindanao.

Quality of fiber.—White, as the word implies.

Quantity of fiber.—One and one-fourth pounds dry fiber to 100 pounds of stalk.

8. BAGUISANUN.

It is just as easy to recognize this variety at first sight as it is to recognize the Tangouan. The light green color pervading the whole stalk down to the very base, as well as the great height and size to which the stalks grow, make it a very easy thing to identify this variety.

In making the tuxy, it behaves very badly. The tuxy often ends in the middle of the sheath, or toward the end, and the man can never pull the tuxy to the end, due to the weakness of the fiber. On this account, all strippers avoid Baguisanun as much as they can. If the stalks were left ten or fifteen days on the ground they could be tuxied, only the tuxy gets darker in color, and the fiber changes to a somewhat dull color.

Color of stalk.—As mentioned above, the stalk is almost all light green.

Size of stalk.—The stalks grow to a greater height and size than in any other variety.

Shape of stalk.—Thickness at the base about double that at the top.

Tendency to produce suckers.—It produces more stalks to the hill than any of the above varieties and the stalks are packed close to each other making it a difficult task to cut the mature ones from among them.

Quality of fiber.—White; also finer and weaker than any of the kinds mentioned above.

Quantity of fiber.—With the present wasteful method not more than 1 pound of fiber to 100 pounds of stalk can be obtained. A machine will save a great deal of the weak fiber wasted in tuxy making.

9. AGUTAY.

Among the 220,000 hills which we have on our place, I could not find more than three hills of this variety. Some years ago there were a good number of them, but as soon as their nature was revealed, they met their fate.

The same difficulty met with in tuxy-making in the Baguisanum is found here, the fiber being about as weak.

Color of stalk.—Deep green with dark lines, almost approaching Libuton.

Size of stalk.—I have not seen stalks over 11 feet in height and 1½ feet in thickness.

Shape of stalk.—Similar to Puteean.

Tendency to produce suckers.—Thirty stalks to the hill is not an uncommon sight; it has the greatest tendency to produce suckers.

Quality and quantity of fiber.—About the same as in Baguisanun.

CONCLUSION.

In applying the requisites of a good abacá plant to the above varieties, it will be seen that the best to pick seed or root sections from are the Tangouan, Maguindanao, Libuton, and Bangulanun, while the planter will be safe even with Arupan and Lumawaan. The Puteean, the Baguisanun, and the Agutay should be carefully avoided for the reasons above stated.

PERIODICALS NOW BEING RECEIVED BY THE LIBRARY OF THE BUREAU OF AGRICULTURE.

ENGLISH.

Agricultural Gazette, New South Wales.
Agricultural News, Barbadoes.
California Cultivator, Los Angeles, Cal.
Crop Reporter, Washington, D. C. (Published by the Secretary of Agriculture).
Exporters' and Importers' Journal, Chicago, Ill.
Far Eastern Review, Manila, P. I.
Farmer and Fruit Grower, Jacksonville, Fla.
Farmers' Guide, Huntington, Ind.
Farm Press, Chicago, Ill.
Federal Reporter, New York, N. Y.
Hawaiian Forester and Agriculturist, Honolulu.
Hemp Market Report, Landauer & Co.
Ide and Christie's Monthly Circular.
Independent Farmer, Lincoln, Nebr.
Iowa Agriculturist, Ames, Iowa.
Journal of Agriculture and Horticulture, Montreal, Canada.
Journal of the Department of Agriculture, Victoria.
Journal of the Department of Agriculture, Western Australia.
Kansas Farmer, Topeka, Kans.
Louisiana Planter, New Orleans, La.
Memoirs of the Department of Agriculture, India.
Natal Agricultural Journal.
Official Gazette, Manila, P. I.
Oregon Agriculturist.
Philippine Journal of Science, Manila.
Progressive Farmer, Raleigh, N. C.
Queensland Agricultural Journal.
Smith and Schipper's Monthly Report, New York.
Southern Cultivator, Atlanta, Ga.
Tropical Agriculturist, Colombo, Ceylon.
Tropical Life, London.
West Indian Bulletin, Barbadoes.

SPANISH.

Anales Agronómicos, Santiago, Chile.
Boletin de Agricultura, Costa Rica.
Boletin de la Cámara de Comercio Filipina, Manila, P. I.
Hacienda, La, Buffalo, N. Y.
Hacendado Mexicano, El, Mexico.
Prácticas Modernas é Industrias Rurales, La Coruña, Spain.

OTHER LANGUAGES.

Berichte uber Land-und Forstwirtschaft.
Der Pflanzer.
Boletim de Agricultura, Sao Paolo.
Boletim de Museu Goeldi, Para, Brazil.
Bulletin de la Chambre de Commerce de Saigon.
Bulletin Econimique, Indo-China.
Journal de Agriculture Tropicale, Paris.
Tamil Journal of South Indian Agriculture, Madras, India.

PLATE I. NATIVE FEMALE PAPAYA TREE WITH FRUIT GROWING IN SINGALONG.

THE PHILIPPINE

Agricultural Review

VOL. II APRIL, 1909 No. 4

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

INTERNATIONAL RUBBER AND ALLIED TRADES EXHIBITION, LONDON.

The leading article of this number of the REVIEW is an extract from the report of Mr. R. Derry, co-commissioner for Malaya, on the International Rubber and Allied Trades Exhibition held in London, September 14 to 26, 1908.

In many respects this is the most comprehensive article on the rubber industry which the REVIEW has been able to present. Mr. Derry carefully takes up the different families and species of the rubber plant which

are raised in the various countries of the world and discusses the cultivation and production of each kind, in a manner which will be very instructive to those interested in the rubber industry.

The most interesting features of this report are Mr. Derry's statements regarding the plantation industry. He states that more than two-thirds of the supply for the rubber markets of the world to-day come from the wild forests of rubber trees in South America, Africa, Eastern and Indo-Malaya; that the rubber plantation industry is in its infancy,—the whole output of plantation rubber amounting to less than 38,000 tons as compared with a total output of over 103,000 tons; and that Manaos, and not Para, is the largest port for rubber in the world. It is very evident that when the large number of rubber plantations which have been started in the Federated Malay States, Ceylon, and other parts of the world, come into bearing, as they will in a few years, there will be a decided increase in the output of plantation rubber. He also points out that the wild rubber forests are being gradually exhausted making it clear that we must soon depend largely upon plantation rubber to supply the demands of the world's market.

That part of the report relating to the Allied Trades Exhibit of manufactured rubber, such as tires for carriages and automobiles, tiling, mats, sheets, ebonite, gutta-percha, athletic goods, and the almost innumerable list of articles which are made from rubber, as well as its use for tanning hides, would indicate the infinite uses which may be made of the product of the rubber tree and the consequent increasing demand for it in the markets of the world.

RICE CULTURE IN THE PHILIPPINES.

From the report of the Collector of Customs for the fiscal year ending June 30, 1908, it is seen that the rice importations during the year amounted to 357,532,514 pounds, valued at $5,861,256, or 19 per cent of all the imports for the year, representing an increase of 43 per cent over the quantity imported during the previous year. Rice from the French and British East Indies and Siam constituted the bulk of this trade; the importations from French East Indies amounting to 336,156,116 pounds; those from Siam to 18,562,337 pounds, while British East Indies contributed 2,660,258 pounds.

Although the value of the rice imported during the fiscal year was $5,861,256, as above stated, duties were paid on these imports amounting to $1,254,515. It is easily seen that had the rice necessary to supply the demand in the Philippines been raised by the agriculturists of these Islands, the people of this Archipelago would have been not only ₱11,722.512 richer by reason of the value of the amount of rice imported, but in addition to this they would have been ₱2,509,030 richer,

the amount which they paid out for duties thereon. In short, had the farmers of the Philippines raised and harvested enough rice to meet the demands for home consumption there would now be ₱14,231,542 more in circulation in these Islands, instead of in the French and British East Indies and Siam, as it is to-day.

In response to the request by the Director of Agriculture dated December 9, 1908, for further information regarding rice culture in these Islands, a number of reports have been received and two of them are presented in this number of the REVIEW. These articles, "Rice Culture in Nueva Ecija," and "Rice Conditions in Bataan and Pampanga" give the local classification and names of the varieties cultivated in those sections and the uses made of them. In most cases the names of the different varieties seem to have only a local significance, and are of little or no value in an exact or scientific classification. Without doubt many of the varieties which appear under different names belong to the same family or species, although presenting the variations indicated.

In this connection also, some attention has been given to the insect enemies of the rice plant and the diseases which have been reported in the provinces mentioned.

It is the desire of this Bureau to make a careful and thorough study of rice cultivation in these Islands with a view to determining the varieties planted at present, and assisting farmers in selecting for future planting those varieties which are of most value, which give the largest yield, and bring the best prices in the local markets; as well as, to determine the best means of eliminating the insect enemies and diseases of the rice plant; to the end that Philippine farmers may be encouraged to supply the demands of the home market for rice, and thus enrich the country, from its present status, to the extent of ₱14,231,542 annually, by putting this amount of money into circulation in these Islands, instead of in French and British East Indies and Siam.

PANAMA HATS.

It is desired to call the attention of our readers to the article in this number of the REVIEW on the Panama hat industry, by United States Consul-General Alban G. Snyder, of Bogotá, and Consul P. P. Demers, of Barranquila, Colombia.

From the statements of these gentlemen, it will be seen that *Carludovica palmata* is used in the manufacture of hats in Panama and Colombia the same as buri, nito, bejuco, sabutan, nipa, and other palm products are used by the people of the Philippine Islands for the purpose of making petacas, hats, and mats or petates.

From the process described by Consul-General Snyder it is seen that

the methods employed in Panama and Colombia are almost identical with those used by the makers of petacas, hats, and mats in Dumarao and other towns of Capiz Province, Baliuag in Bulacan, Calasiao in Pangasinan, and some towns in Batangas.

From the further description and statements regarding the cost of these hats, made by Consul Demers, it will be seen by those familiar with the industry that the same conditions which are regarded as favorable in the Philippines are so considered in Panama and Colombia. Perhaps the most difficult part in the whole process of hat making, and the only one that requires an expert, is that of boiling and preparing the crude product for use in weaving hats and mats.

It will be seen that the most expensive hats which have sold in time past, and even now sell at exorbitant prices, in some instances as high as $150 each, cost but little more than $60 per dozen.

In case the plants of *Carludovica palmata* which have been set out at the Lamao Experiment Station do well and develop satisfactorily in these Islands, there would seem to be no reason why this most profitable industry could not be taken up and carried on by some enterprising person in the Philippines with comparatively little capital.

SUPPLY AND DEMAND.

The continued low price of hemp, which is one of the most staple products of the Philippines and one upon which planters for years past have relied as an unfailing source of income, and the unusually large crop of sugar which is promised in the Visayas, call attention to the very important questions of supply and demand.

In the United States as well as in the Philippine there has always been a tendency on the part of farmers to select one crop, generally a staple which promises a good profit, and give their attention to it to the exclusion of almost all other agricultural products which might be grown as easily as this one crop, to which they devote nearly all of their time and money. In such cases it is always the experience of farmers that at intervals the price of their staple crop falls and they realize scarcely any profit; some times their crop is a financial failure because there is no demand for it in the market.

It is desired to call the attention of agriculturists in the Philippines to the fact that it is of the utmost importance that they study carefully the demand of the local and world markets not only of to-day, but the probable future demand for the leading agricultural staples—crops which in view of commercial conditions will be needed in large quantities and will consequently command high prices. The farmer who plants and harvests a crop without studying carefully the conditions of supply

and demand in the local and world markets is sure, sooner or later, to suffer unnecessary loss in his business, if not at some time the total loss of the crop which he harvests, because there is no demand for it.

This failure to study the conditions of supply and demand is, perhaps, well demonstrated by the large crops of unharvested hemp, and hemp stored in camarins, not only in the Philippines, but in New York and London, for which there is little demand, and on account of which there has been a prevailing low price for this product. As to whether the price of hemp will ever go up to its old standard depends not only upon the demand for the products which hemp is used to make, but on the other hand as to whether other plants which are being cultivated at the present time can supply a fiber to take the place of hemp, at a lower price.

The conclusion, perhaps, of the whole matter is that security for Philippine agriculturists, as well as for farmers in the United States, is to give attention to and to cultivate such a variety of crops as their lands will produce with profit. The fact that in the Philippines hundreds and perhaps thousand of agriculturists, year after year, have depended almost entirely upon the income from one crop (hemp, sugar, or tobacco), to the practical exclusion of all others, has been the cause of many hardships not only to the planters but to those dependent upon them for employment. In many cases, this lack of demand for a certain agricultural product has worked hardships to the common people in the hemp, sugar, and tobacco sections which only those living in these sections realize. We must not look forward to free exports into the United States or free imports into the Philippines as a panacea, or expect them to bring prosperity and progress; *we must produce the articles demanded by the local and world markets.*

THE DIRECTORY.

In this number of the REVIEW we are giving a directory of the Bureau of Agriculture with the idea that it may be a help to those interested in our work and assist in the dispatch of the business of this Bureau with the public. It is hoped that those desiring to take advantage of the services of any department or branch of the Bureau of Agricultural at the central office, stock farms, experiment stations or veterinary offices may, by the help of the directory, do so with the greatest economy of time both to themselves and the officers of the Bureau.

PAPAYA JUICE.[1]

Papaya juice is extracted from the fruit of the papaw tree, which grows rapidly, attaining its full bearing capacity in a year. It produces from 40 to 50 papaws of a dark green color, ripening to a deep yellow, in shape resembling a squash. A very light superficial incision is made in the fruit, and a clear water-like juice exudes therefrom, which becomes opaque on exposure to the air. As it drips from the fruit it is received in a porcelain lined receptacle. As it is very corrosive, metal receptacles would injure its appearance and qualities. It possesses great digestive virtues, and the refined article is considered superior to all animal pepsins.

After the desired quantity has been collected, the juice is placed in shallow porcelain or glass-lined pans and allowed to evaporate. While this is not a very delicate or difficult operation, it requires considerable attention, so that the juice will dry uniformly and the product be white and well granulated. In its granulated state it is shipped to the United States where it undergoes a refining process, and is sold as the papaw of commerce for medicinal purposes.

The ripe papaw is palatable and an excellent aid to digestion. Meat wrapped in papaw leaves for a short time becomes quite tender without any impairment in appearance or taste.

In extracting the juice the hands should be protected by rubber gloves, as in its crude state it attacks the tissues. An average tree will produce about one-fourth of a pound of the granulated juice. It sells in the United States for from $4 to $6 per pound in the crude state.

"(Papaya, *Carica papaya L.* (*Passi oraceæ*). A tree commonly cultivated for its edible fruits, introduced from America. The papaw. Merrill." A great many types of this tree grow in these islands. It is subject to great variations in growth, gives a heavy yield per acre, and makes good hog feed. When set out 10 by 10 feet apart and cultivated it improves greatly in quality and quantity of yield.—Editor.)

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[1] **Extract from annual report of United States Consul A. J. Lespinasse, Tuxpam, Mexico.**

Plate II. CARICA PAPAYA, MALE TREE IN BLOSSOM.

PLATE III. ROUND VARIETY OF PAPAYA FROM HAWAIIAN SEED.

Plate IV. LONG VARIETY OF PAPAYA FROM SINGAPORE SEED.

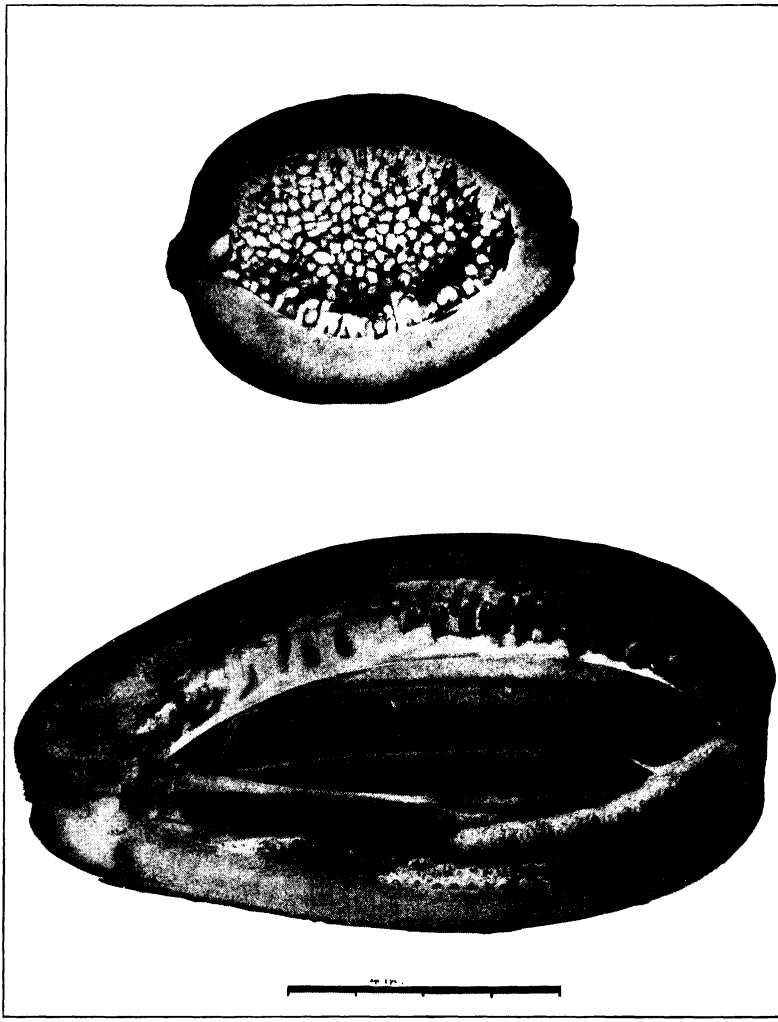

PLATE V. FRUIT OF LONG AND ROUND VARIETIES OF PAPAYA CUT OPEN.

THE PANAMA HAT INDUSTRY.

By Alban G. Snyder,

United States Consul-General, Bogota, Colombia,[1]

and

P. P. Demers,

United States Consul at Barranquila, Colombia.[2]

Owing to the large demand for Panama hats, Americans may be desirous of engaging in the business. I see no reason why the "palmicha" palm would not grow readily in the Philippines. Anyone desiring to start this industry there can get an expert boiler and hatter in Colombia at small cost to teach the art.

These hats are made from the common fan-shaped palm, called "palmicha," which grows wild in abundance, generally in moderate climate and fairly moist ground. Young shoots, uniform in size, are cut from the plant and boiled to a certain stage, being softened thereby and brought to a light yellow color.

The process of boiling appears to be an art in itself, and only a few people can turn out good straw. The boilers sell the straw at so much a pound, according to the quality and the prevailing prices of hats.

When the proper boiling point is reached, the shoots are put up to dry and the leaves quickly separated. This is done indoors where there is a current of air but no sunshine. When the leaves are nearly dry they are split with a little Y-shapped wood instrument, so that every good leaf is the same size. When left alone to dry the leaves curl in at the edges and are then ready for use. At this point the straw is carefully wrapped in clean cloths, as the light and dry atmosphere spoil it. When finished the straw is carefully pared with a pocketknife and then battered all over with a small hand maul, after which it is washed with common yellow soap and a little lime juice and left to dry, away from the sunlight.

In the Suaza district they make the hats on solid wooden blocks, two to four persons—generally women—sitting opposite each other and working steadily. Four women can make an average quality hat in six or seven days, while a fine one requires three to six weeks.

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[1] From United States Consular Report for April, 1904.

[2] From United States Consular and Trade Report for March, 1907.

The hats made in the Suaza district in Colombia are considered much superior to those made in Ecuador. About a year ago an average Suaza hat cost about 45 cents first hand, a good one $1.50, and a very fine one $3; but prices have varied according to the demand and during the last two years they have been rising steadily, and now, at times, as high as $5 and $6 is paid for them—and not the very finest at that.

The manufacture of these hats is affected to a great degree by climatic influences, an expert hatter being unable to make as good a hat in the dry summer weather as during the rainy season; probably on this account hats in some parts of the Suaza district are superior to those made just a short distance away.

Long training is necessary to become a good hatter, and the girls are started at the work at the very early age of 10 years and must practice constantly. Hatters work every day from early morning, wasting very little time in eating, and often carrying on their work by candlelight so as to finish in time for market, for an hour may mean to them the loss of a market day and the corresponding inconvenience caused by failure to receive the money which would have been acquired from the sale of the hat.

Consul P. P. Demers states, in a letter from Barranquila, that one of the important industries of the Republic of Colombia is that of making palm hats, known as Panama hats, of which nearly $400,000 in value are exported annually.

This industry follows in importance those of coffee, gold, hides, cattle, tobacco, and rubber, in the order named, and is carried on in the departments of Cundinamarca, Tolima, Antioquia, and Santander, but mostly in the latter where it is the breadwinner of more than one-half the population. There are no regular factories, but the hats are handmade by thousands of peasant women in almost as many households and sold or traded in the local stores in exchange for provisions or articles of clothing, the hat being in these regions a convenient medium of exchange, the housewife exchanging the product of her labor for so many pounds of flour, sugar, etc.

HOW PANAMA HATS ARE MADE.

Panama hats are made with the veins or fibers of palm leaf, the tissues of which are scraped off or combed in much the same way as hemp. The palm (*Carludovica palmata*), called locally "jipijapa," is very small in appearance and grows in great quantities on the low and swampy lands of the upper Magdalena. It grows wild but is also cultivated, although to a limited extent, in the largest hat districts, the palm producing in a little over a year. The preparation of the fiber after the tissues have been combed off consists of boiling the same in water containing salt and lemon juice for whitening and rounding its surface; this operation takes a few hours. The straw is then exposed

to night air for three consecutive nights, after which it is ready for use. The material employed in the making of a hat is marketed at from 15 to 40 cents, or the equivalent thereof, per hat, according to the fineness and whiteness of the straw, the youngest leaves generally giving the best quality. It takes a woman four days to make an ordinary hat, eight days for a good one, and as many as fifteen days for the finest hat made in Colombia. The salary of the peasant woman employed in the making of a "jipijapa" hat is recokoned at 10 cents a day, including her food, which can be calculated at 10 cents additional.

The best hats exported from this country are those called "Suaza," made in the city of that name in the Department of Cundinamarca. The next in order are the "Antioqueños," made in the Department of Antioquia. Then follow the ones made in the Department of Santander, called, respectively, "Zapatoca," "Barichara," "Bucaramanga," and "Giron," from the various cities in which they are made, and varying in quality and price in the order named. But the "Zapatoca," although the most expensive from Santander, are supposed to be less durable.

METHOD OF SHIPPING.

The best Suaza hat exported costs on the premises $5, the cheapest of all being those from the Department of Santander, which range from 50 cents to $2, according to the quality. Indeed, some Panama hats, made at the rate of one a day, sell for less than 50 cents but these are made exclusively for home consumption and are not exported.

Hats are generally exported by the local merchants, mostly through the agency of a commission house at the port of shipment. In some cases foreign houses buy direct, whereas a few individuals take their own merchandise to the foreign country where it is marketed by them personally. The hats are packed in boxes weighing 132 pounds and containing from 40 to 50 dozens each. The shipping costs, per box, are as follows: Packing and boxing, $2; mule freight to river port, $1; river freight to port of shipment, $1, plus 1 per cent ad valorem; freight to New York, three-fourths of 1 per cent, or 20 cents per cubic foot, plus 5 per cent, should measurement be more than value; commission, etc., about $1 per box. Thus boxes containing 40 dozens of the best $5 Suaza hats, and the cheapest kind exported, 50 cents, will cost in New York the following:

Item.	Best Suaza.	Cheapest.
Purchase price	$2,400.00	$240.00
Packing and boxing	2.00	2.00
Mule freight to river	1.00	1.00
River freight to port of shipment	25.00	3.40
Commission, etc.	1.00	.50
Freight to New York	18.00	1.30
Total cost of 40 dozens	2,447.00	248.20
Total cost per dozen in New York	61.17	6.20

Panama hats exported from Colombia to the United States may then vary in value from $6.20 to $61.17 per dozen. It is absolutely impossible, without examining the contents of each box, to put the right value on an average shipment, as it is the custom here to include many classes of hats in the same box. It can be rightly supposed, however, that the average hat exported to the United States from this country is at least of a fair quality.

GROWTH OF EXPORTS TO AMERICA,

The first Panama hat sent from this port to the United States was in 1899, and the trade to the present time has increased, as the following statistics of Panama hats exported to the United States from Barranquila alone will show, for the fiscal years which ended June 30: in 1899, $536; in 1900, $518; in 1901, $14,425; in 1902, $84,342; in 1903, $112,649; in 1904, $111,103; in 1905, $79,448; and in 1906, $151,676. The figures given represent the declared value in the consular invoices, averaging approximately 75 cents per hat, a very low estimate.

As above explained, Panama hats are made in a most primitive way. Accordingly, any machinery invented which could increase the output materially and at the same time reduce the number of employees would be a great benefit to the industry which is very attractive, since it needs but a small capital and promises good returns to anyone engaging in it systematically.

(Ten plants of this species (*Carludovica palmata*) were recently imported from Ceylon and planted about March 6, 1909, at the Lamao experiment station, for trial and propagation, if satisfactory.—EDITOR.)

THE AGRICULTURAL CONGRESS OF PANAY AND NEGROS.

By the EDITOR.

Probably one of the best movements ever made for the agricultural progress and prosperity of the southern islands is that of the Agricultural Congress of Panay and Negros, the second annual meeting of which took place at Iloilo on January 30, 31 and February 1, 1909. This meeting was attended by two or three hundred delegates from Panay, Negros, and the surrounding islands of the Visayas, including not only the leading farmers and business men of that section, but also several members of the Philippine Assembly, among whom were Señores Hernandez, Avanceña and Jalandoni of Iloilo, Villavet of Antique, and Rodriguez of Cebu. The Bureau of Agriculture was represented by Sr. Tecson, superintendent of the agricultural extension work.

The following program was carried out, with a few slight variations, under the chairmanship of Señor Juan de Leon, provincial fiscal of Iloilo:

PROGRAM.

1. The necessity of increasing the capital stock of the Agricultural Bank of the Philippines, by Señor J. Lopez Vito.
2. Legislation covering the relations between capital and labor, employer and employee, by Señor J. Hernandez.
3. The importance of taking steps to obtain the greatest advantage in disposing of the sugar product of the Visayas, by Señor E. Guianko.
4. The necessity of a Government loan for the purpose of establishing a Philippine irrigation system, by Señor R. Montinola.
5. The necessity of establishing a Government station in Iloilo for grading and regulating the tare on sugar, by Señor F. Villanueva.
6. A law providing for the improvement of the port of Iloilo and dredging the rivers of Panay and Negros, by Señor Juan de Leon.
7. Better laws to facilitate obtaining titles to agricultural lands, by Señors Vicente Franco and J. Hernandez.
8. The advantages of scientific and varied cultivation, by Dr. G. E. Nesom.
9. The need of improving the animal industry, by Señor Jose de la Rama y Gonzaga.
10. The necessity of establishing agricultural and veterinary colleges in all provinces of the Archipelago, and the further introduction of practical agricultural instruction in the primary and secondary schools, by Mr. Charles H. Magee.
11. A law providing for the exemption of the tax on carts having less than 2-inch tires when the same are used only on the farms of the owners and not on the public roads, by Señor Vicente Gamboa Benedicto.

12. The importance of encouraging the organization and establishment of agricultural fairs and expositions in different sections of the Islands, by Señor N. Severino.

13. Which of the various lines of railroad projected on the Island of Negros will most benefit the agriculturists of the island? by Señor S. Laguda.

14. The necessity of requiring a fixed number of government students to take an agricultural engineering course, by Señor M. Fernandez.

The question of the establishment of a Government station for the grading of sugar in Iloilo was discussed at length, and communications regarding the matter were sent to the Governor-General and the Philippine Legislature. It was believed that such a station, if established, would be a great benefit to the sugar growers of Panay and Negros, and that the chief or superintendent of the same should have full authority under the law to determine the grading of all sugars bought and sold in those sections. It was also recommended that the Government establish a court which should have jurisdiction over all cases arising from the sale of sugar or the dealings of those engaged in the sugar business, the expenses of the same to be paid by those utilizing its services.

One of the resolutions passed by this congress recommended the establishment of a serum laboratory in Iloilo and a quarantine station in Occidental Negros.

The congress also seemed to be under the impression that the present force of the veterinary division of the Bureau of Agriculture is insufficient, and that a larger number of competent veterinarians should be employed to keep down the prevailing cattle diseases.

With reference to the work of this congress, the editor is very forcibly reminded of the following statement made by Prof. Edward C. Parker, who was recently employed by the Fengtien government to establish the Agricultural College and Experiment Station at Mukden. Speaking of agricultural development in Manchuria, Professor Parker says:

> The agricultural problem in Manchuria is not so much the problem of making two blades of grass grow where one grew before, as to change the existing economic and social conditions of farm life into an advanced condition of commercial agriculture in which the farmer can produce a surplus of food above local demands and find a ready cash market for that surplus. * * * If good roads could connect with railways and waterways in Manchuria and if capital could organize the facilities for storing and shipping staple agricultural products, thus bringing relatively high prices for these products into every community, there is little doubt but that Manchuria would produce a large surplus of crops for export and in striving to produce a surplus the farmer would be quickened and fully awake to the advantages of improved methods of agriculture.

The above statement of conditions in Manchuria applies equally well to the Philippine Islands. Our need is to change the existing social and economic conditions of farm life, to build good roads, and railways, and to improve waterways, in order to stimulate production by bringing higher prices for farm products into every community.

THE PROVINCIAL BOARD OF TAYABAS AND ENEMIES OF AGRICULTURE.

By the EDITOR.

The attention of provincial boards throughout the Islands is invited to the following resolutions recently passed by the provincial board of Tayabas with reference to the appearance of locusts and surra in that province.

LUCENA, TAYABAS, *September 25, 1908.*

Whereas in various municipalities of the Province of Tayabas it has been shown that there are locusts which threaten to decimate the growing crops to such an extent as to constitute an agricultural plague; and

Whereas section 13, paragraph (*k*), of the Provincial Government Act provides that provincial boards shall enact rules for the stamping out of agricultural plagues:

Therefore, the undersigned, provincial governor of Tayabas, proposes for the approval of the provincial board the following rules for stamping out the locust or grasshopper plague:

I. Any person who discovers locusts or grasshoppers at any place in the Province of Tayabas shall immediately report the same to the teniente of the barrio where said locusts or grasshoppers exist and the said teniente shall immediately notify all the capable inhabitants of the barrio, together with the teniente and inhabitants of the adjacent barrios that they will be required to give their services for the extermination of such locusts or grasshoppers. He shall also immediately report the case to the local authorities of his municipality.

II. Any local authority who receives notice of the existence of locusts of grasshoppers within his municipality shall report the same to the presidente, who shall order all of the councilors of the municipality to coöperate with the inhabitants of the respective districts in the extinction of said pests. The presidente shall also report to the provincial governor the existence of locusts or grasshoppers within his municipality, stating what steps have been taken for their extinction. He shall, if possible, call a special meeting of the municipal council for the purpose of adopting proper measures regarding the extinction of the locusts or grasshoppers and should funds be necessary for this work, the council shall vote the required amount from the general funds of the municipality; and in case the municipality has not sufficient funds on hand therefor, the council shall ask for assistance from the province.

III. The municipal presidente and councilors of any municipality where locusts or grasshoppers appear in such numbers as to become an agricultural pest or plague, shall constitute themselves a board to direct the work of extinction.

IV. Every person who is subject to the last two rules above set forth and who fails to fulfill the conditions thereof, shall be declared guilty of a public offense and fined an amount not to exceed ₱200, or imprisoned not longer than

thirty days, in the discretion of the justice of the peace who, in the judgment of the provincial board, is competent to try all violators of these rules.

V. The amounts accruing in each town from fines or infractions of these rules shall constitute a special fund which shall be deposited with the municipal treasurer for the purpose of defraying the necessary expenses of the work of stamping out the locusts or grasshoppers, under the direction of the municipality.

VI. Six official copies of these rules shall be sent to each municipal secretary of this province, one of which shall be for the justice of the peace, and the other five shall be posted in the most conspicuous places in the town. Official copies shall also be furnished the judge of the Court of First Instance of Tayabas, and the Director of Agriculture, Manila.

Approved:

DOMINGO LOPEZ, *Provincial Governor.*
LUCIANO L. SANTOS, *Secretary.*

LUCENA, TAYABAS, *October 12, 1908.*

Whereas the animal disease known as surra is said to exist in the Island of Marinduque; and

Whereas the said disease has spread to some municipalities of this province by infection from diseased animals exported from the said Island of Marinduque; and

Whereas, if this evil is not removed, not only will agriculture suffer locally in this province but in the Islands generally:

Therefore, in compliance with paragraph (*k*), section 13, of the Provincial Government Act, the provincial board of Tayabas enacts the following rules for the stamping out of this disease.

I. The exportation of cattle from any port of the Island of Marinduque to the towns of this province, or other provinces in the Philippine Islands, is prohibited indefinitely; except for the port of Santa Cruz, from which cattle that have been previously certified by the Government veterinarian as healthy and unable to carry infection to other animals, may be exported.

II. Every violation of this resolution shall be punished by a fine of not to exceed ₱200, or imprisonment not to exceed 30 days, or by both such fine and imprisonment, in the discretion of the justice of the peace who trys the case. Justices of the peace of the said subprovince of Marinduque shall have power to try all persons who violate the provisions of this Act.

III. These rules shall take effect on October 14, 1908, and shall remain in force until otherwise ordered by the provincial board.

IV. Seven official copies of these rules shall be sent to each municipal secretary of the subprovince of Marinduque, one of which shall be furnished to the justice of the peace, one to the municipal-president, and the other five shall be posted in the most conspicuous places in the town. Official copies shall also be furnished the judge of the Court of First Instance of Tayabas, and the Director of Agriculture, Manila.

Approved:

DOMINGO LOPEZ, *Provincial Governor.*
LUCIANO L. SANTOS, *Secretary.*

The prompt action of the provincial board of Tayabas on the occasion of the appearance of locusts and surra in that province is most heartily commended by this Bureau, inasmuch as in times past it has seemed to be the custom of municipalities and even provinces to immediately

call upon the Bureau of Agriculture or the Insular Government for help without taking the necessary preliminary steps or precautions such as were taken in the cases above mentioned to prevent the spread of the pest or plague.

In this connection the attention of provincial and municipal officials, as well as that of the reader, is invited to the very simple instructions regarding rinderpest, surra, foot-and-mouth disease, anthrax, hog cholera, glanders, hemorrhagic septicemia, and ulcerative lymphangitis contained in Volume I, No. 3, of the REVIEW for March 1908, also General Order No. 13, by the Bureau, published in Volume I, No. 11, of the REVIEW for November, 1908.

By following these instructions provincial officials will find it easy to confine a pest or plague to the locality in which it appears until it can be eradicated by the local authorities or by the assistance of this Bureau and such other Insular aid as may be necessary. In many cases prompt action by municipalities and provinces following out the above mentioned instructions will be all that is necessary without assistance from the Insular Government. While this Bureau is anxious to give all the assistance it can to provinces and municipalities throughout the Islands, the efforts made in some provinces to stamp out diseases which have appeared in different parts of the Islands are greatly appreciated. Without such coöperation by municipalities and provinces it is impossible to get results, while in most cases much more can be accomplished by them toward the eradication or stamping out of the dangerous animal diseases in the Islands than by any other department of the Government.

BRASSOLIS ISTHMIA, A COCONUT PEST IN PANAMA.

A LEPIDOPTEROUS INSECT HIGHLY INJURIOUS TO THE COCONUT.

The attention of coconut growers in these Islands is called to the following facts regarding the above insect, from a report of Mr. Henry F. Schultz, Horticulturist for the Canal Zone, Isthmus of Panama.

Early in May, 1906, the majority of the coconut trees in the neighborhood of Ancon were defoliated by the attacks of a caterpillar. Large trees which had been bearing crops for a number of years stood without a particle of foliage with their bare petioles and midribs resembling skeletons. Some of the trees had to be cut down but the remainder recovered under the special care given them.

Later in the same year, about the middle of September, the caterpillars again appeared, although not in as large numbers as before, and began to strip the trees anew. All coconut trees were, therefore, sprayed with a strong solution of arsenate of lead, a most tedious and troublesome, although very effective, method of fighting these insects, in view of the height of the tree, which were mostly from 30 to 35 feet. Although torrential rains washed off the arsenate of lead after a few weeks, it stayed on long enough to kill all the insects on the trees which had received treatment.

This year the caterpillars made their appearance again in May. Apparently this is the time of year when the mature insects deposit their eggs freely on all coconut trees in the vicinity, for about the latter part of August thousands of their larvæ began to defoliate these palms again and were evidently determined not to leave a single leaf on the trees. However, one fact was noticed, viz, that the larvæ feed only at night and that they retire before the first rays of the sun into a tough webb spun with pinnæ of the leaves, where frequently as many as 700 to 800 crowd together in one nest. The lower part of this, where the ends of the pinnæ meet, is left slightly open and the nest presents the appearance of a long narrow bag from 30 to 60 centimeters in length, according to the number of insects it contains. Frequently a tree will have two, three, or even four of these nests and some were found where the number of full-grown larvæ were estimated to be over 2,000. What even half of this number can do to a full-grown tree if their ravages are not speedily stopped can be imagined, especially if the fact is kept in mind that they attain the respectable size of 5 to 10 centimeters in length and have enormous appetites like most caterpillars.

A bearing coconut tree will thus be stripped of every inch of its foliage in a few nights and receive such a severe check in its growth that even with all due care in preventing the reappearance of the pest in following years, at least two or three crops of nuts will be lost, and it is no rare occurrence that a tree dies outright or becomes so weak that it can not resist fungoid and other diseases, and gradually perishes.

After reaching maturity or when the supply of food gives out, the larva passes into the chrysalis stage, in which it remains twelve to sixteen days, and this is the time when the larvæ of an apparently dipterous insect help in the extermination of *Brassolis*. It has been impossible to determine whether the mature parasite deposits its eggs into the skin of the caterpillar or into the chrysalis, or whether its ova are introduced through the alimentary tract of the larvæ with its food. Dr. Darling, chief of the board of health laboratory at Ancon, has examined mature larvæ of *Brassolis* under a high-power microscope without finding any traces of parasitic ova in either the skin or the intestinal ducts. However, as only a small number were examined on account of lack of time, it is possible that the few specimens observed were not infected with parasites.

As the parasitic larvæ are not protected with a skin, which in the judgment of the writer would be tough enough to withstand the gastric juices of *Brassolis,* the probability of cutaneous infection suggests itself. The destruction of *Brassolis,* through its parasites seems to be rapid, though the actual time can not be given, as those in captivity seem to be free from infection.

As previously stated, the larvæ feed only at night and try to hide in their nests during the day, but this hiding becomes in realty a means of their being more easily detected and destroyed, for it is a great deal easier to cut down these nests than to spray the trees. However, this requires constant vigilance on the part of the grower, as in the groves where the tree tops frequently touch each other the caterpillars can crawl from tree to tree.

The writer seems to believe that *Brassolis* is one of the most formidable enemies of the coconut grower if it is allowed to spread, and that every possible attention should be given to the immediate destruction of the larvæ at their first appearance.

The *Brassolis isthmia* has also been found on the following palms: *Martinezia caryotaefolia, Acrocomia solerocarpa, Oreodoxa regia, Oleracea,* and two unidentified species of *Thrinax.*

Any coconut growers who find that *Brassolis isthmia* has made its appearance in these Islands are requested to advise the Bureau of Agriculture at once, giving all the details possible with reference to its ravages in their vicinity.

RICE CULTURE IN NUEVA ECIJA.

The following data concerning rice culture in the Province of Nueva Ecija were furnished by Mrs. C. D. Whipple and the pupils of the provincial school in San Isidro at the close of the harvest for 1907–8.

The rice of this province is grouped three times—

1. According to whether it is with or without a beard or awn.
2. According to whether it is harvested early or late.
3. According to food quality.

All the bearded varieties are grouped as "palay-Iloco," and those without a beard as "palay-Tagalog."

All varieties harvested between July and November are grouped as "paaga" (early harvest), and those harvested after November as "pahuli" (late harvest).

All varieties that may be used to form the greater part of a man's daily food are placed in a group called "macan," while those that are hard and difficult of digestion are placed in another group called "malagkit."

"Palay-Iloco," or the bearded varieties, require less cultivation than the "palay-Tagalog," or beardless varieties, but have less commercial value because of the difficulty in harvesting and thrashing. "Palay-Iloco" can not be thrashed by carabaos like "palay-Tagalog," but is separated from the straw by pounding small quantities at a time in a mortar.

It is cut three or four stalks at a time with a short knife and tied into small bundles or bunches. Six of these little bunches make a "ponpon" and forty-four "ponpons" make an "hoyon." This is the way "palay-Iloco" is measured and when harvesting these bearded varieties it is the custom to give the harvesters every fourth or sixth bunch in addition to the regular daily wages, but this custom does not pertain to the beardless varieties.

"Palay-Iloco" will also produce a crop with less water than "palay-Tagalog," but in spite of this and other advantages it can not be raised in paying quantities without machinery for harvesting and thrashing.

"Macan" and "malagkit" may be either "paaga" or "pahuli." Of "macan," "mimis" is considered the best variety. "Malagkit" is never used for food in large quantities, but is ground into a fine flour and used for making cakes and several different kinds of sweets. When it is in the "dough" it is pounded and roasted and eaten with sugar and coconut

milk. This is called "pinipig" and many Americans like it as a breakfast food.

In the following list are the names of the varieties of rice raised in Nueva Ecija which were classified by the pupils in the provincial school.

Varieties.	Macan.	Malagkit.	Palay-Tagalog.	Palay-Iloco.	Paaga.	Pahuli.
Mimis	*		*		*	
Sinanpablo	*		*		*	
Macancumpol	*		*			*
Minalit	*		*			*
Maguhay	*		*			*
Ipotibon	*		*			*
Magasa	*		*			
Binulagsac	*		*			
Binundoc	*		*		*	
Pulangbalat	*		*			*
Binato	*		*		*	
Inalsa	*		*			*
Salamani	*		*			
Maranaga	*		*		*	
Bansuray	*			*		
Kinastila	*			*		
Granado	*			*		*
Malayusa	*			*		
Payos	*			*		
Minantica	*			*		
Guinarcia	*			*		*
Quinalabas		*	*		*	
Pirurutong		*	*		*	
Milagrosa		*	*		*	
Pinino		*	*		*	
Nilihim		*	*		*	
Bansuroy						*
Kinamias	*			*		*
Caviteña	*		*			*
Binacal	*			*		*
Sampurin	*			*		*
Calibo	*		*		*	
Dinalaga	*		*		*	
Sinantol	*				*	
Sinaguing	*		*		*	
Virenghena	*		*		*	

The following notes were made by the division superintendent of schools on ninety-one varieties of rice, samples of which were forwarded to him by the teachers and pupils in the Province of Nueva Ecija at the close of the harvest for 1907–8.

1. Alamang (shrimp). Bearded, light red, plump grain.
2. Bansuroy. Bearded, light red, round grain.
3. Barlaque. Bearded, light red, small grain.
4. Bincal, (iron).
5. Binaaruy. Bearded, light brown, small grain.
6. Binanata. Bearded, light red, very small grain.
7. Binandera (flag). Bearded, light brown, plump grain.
8. Binara (vara). Bearded, light red, round grain.
9. Binulingan.
10. Binatik (spotted). Bearded, light red, small grain.
11. Binakroy. Short beard, light color, small grain.
12. Binatad (hard). Bearded, light brown, small grain.
13. Binato (stone). Beardless, light red, round flat grain.
14. Bulilsing. Bearded, brown, small grain.
15. Bulic (gray). Bearded, red, small grain.
16. Buncol.

17. Contenido (plentiful). Bearded, light purple, small grain.
18. Caviteña (Cavite). Beardless, light red, small grain.
19. Casine. Bearded, light red, small oval grain.
20. Calibo (Calivo). Beardless, light brown, small grain.
21. Cuyap-pa.
22. Dinomero (Romero). Beardless, red, small grain.
23. Diquet Uban.
24. Diquet Bulilising.
25. Dinagupan (Dagupan).
26. Diquet Balakinao.
27. Diquet Daldal.
28. Enero (January). Bearded, very dark red (almost black), thin flat grains.
29. Ganado (cattle).
30. Garay-gay.
31. Inasiman (sour). Beardless, light brown, small grain.
32. Igorot. Bearded, reddish purple, small grain.
33. Inimsima or Puting Mimis (white). Beardless, red, small grain.
34. Inarupel. Beardless, light brown, flat grain.
35. Ipotibon (bird's egg). Beardless, light red, small grain.
36. Inalsa (lifted).
37. Lampacan. Bearded, light color, small grain.
38. Macan Aga (early). Beardless, light color, small grain.
39. Macan Eneng. Bearded, light, red, full grain.
40. Macaliat. Bearded, light brown, plump grain.
41. Macan Pulot (molasses). Beardless, light red, small grain.
42. Minan Duran. Bearded, light color, small grain.
43. Magsuhay (small spikes).
44. Mimes (best). Beardless, light red, small grain.
45. Sinampaga (sampaga). Beardless, light red, small grain.
46. Macan Barus. Bearded, light red, small grain.
47. Magsumpong. Bearded, light color, mixed with brownish red, small grain.
48. Mateusa (to kill). Bearded, red, light oval grain.
49. Malacca Ocho (from Malacca). Short beard, reddish color, heavy head.
50. Macan Bucaue (from Bucaue). Round, plump grain, heavy head.
51. Malagkit (sticky).
52. Macan Cumpol (bunch or cluster). Beardless, light brown, round grain.
53. Macananay-a-bi-it.
54. Manacat.
55. Macan Juana.
56. Mangasa (to hunt with dogs).
57. Macan Señora (lady Macan).
58. Minantica (oily).
59. Nasusena.
60. Principe (from Principe). Bearded, light-colored grain.
61. Paune (early). Beardless, round, plump grain, light color.
62. Palay virgin. Beardless, reddish brown, round seed-like grain.
63. Puteng pirurutong (white). Beardless, red or wine color, striped small grain.
64. Pulang pirurutong (red).
65. Piniling niña (chosen girl). Bearded, light color, round small grain.
66. Puquintan. Light red, beardless, small grain.
67. Portoc. Beardless, round plump grain, light brown.

68. Payus. Bearded, light small grain.
69. Piniling babay (chosen woman). Beardless, very light, round, flat grain.
70. Quinauayan (bamboo). Beardless, light colored, flat grain.
71. Quinastilla (Spanish or white rice). Bearded, light brown, small grain.
72. Quinatuday. Bearded, light color, round plump grain.
73. Quinandelaria.
74. Quinamias (camias). Bearded, light red, oval grain, heavy head.
75. Sinan Felipe (Felipe). Bearded, light brown, round grain.
76. Sinan Jose (Jose). Bearded, brownish red, small grain.
77. Sinablay (drooping). Bearded, very dark red, small flat grain.
78. Sinaging (banana).
79. Sinantol (santol). Bearded, light small grain.
80. Siliquidquid. Bearded, light small grain.
81. Seda (silk). Bearded, brownish red, thin flat grain, smooth head.
82. Sagat. Bearded, light red, small grain.
83. Salumanay. Dark brown beard, long, light, oval grain.
84. Sinampaga (sampaga). Beardless, light red, small grain.
85. Sinampablo (San Pablo). Beardless, light red, small grain.
86. Sinampalian.
87. Sinagat.
88. Sinamporin.
89. Sinampiro (San Pedro).
90. Tinalahib (talahib).
91. Tui. (Name of a tree).

The usual time of planting is July or August. "Alamang" and "macan aga" are planted as early as May; "quinamias" and "calibo" in June.

Average number of stalks in one stool ranges from 5 to 28.

The number of grains on one head ranges from 70 to 405 (405 "binandera" in Licab).

The yield per hectare varies from 10 to 120 cavans; "macan bocaue" and "binatad" yielding as high as the latter figure. Amount raised: "Macan," San Isidro 8,000, Jaen 25,000, Cabiao 14,000, Gapan 45,000 cavans; "binatad," Jaen 25,000, Gapan 10,000 cavans; "bocaue," Gapan 30,000 cavans. The market price on January 1, 1908, ranged from ₱1.50 to ₱5. "Mimis," "macan," and "binatad" bringing the highest prices.

RICE CONDITIONS IN BATAAN AND PAMPANGA.

By José Rivera, Jr.,
Agricultural Assistant, Bureau of Agriculture.

Bataan and Pampanga are largely agricultural provinces, having for their principal crops rice, sugar cane, and corn. This would have been a banner year for rice in these provinces had it not been for the unusually late and excessive rain storms, which caused considerable damage on the plantations. In some cases the loss amounted to 50, or even 60 per cent of the crop. Often fields had the appearance of a veritable lake rather than a growing rice field, though in several instances the crops were matured, or nearly so. To avert any such occurrence, something must be done to improve the lands, and I am of the opinion that a good system of drainage would do much to prevent the recurrence of such flooding.

There are still large tracts of uncultivated lands in both of these provinces, especially in Bataan. This fact is due mainly to the lack of farm animals. But I believe that with a little more perseverance much of this waste land—which it is be regretted is mostly in cogon—could be made a valuable addition to the already rich and fertile agricultural fields.

As the agricultural conditions and the needs of the people of these two provinces differ I shall now consider them separately.

BATAAN.

Bataan is a very mountainous province with a soil well adapted to rice and sugar cane. It is rather poor in comparison with the other provinces visited, and the roads are badly kept.

ORION.

The principal crops in this municipality are rice, corn, sugar cane, pineapple, and coconuts, in the order named. The rice this year was damaged by the storm which swept the province about the first of last October. The rice fields are practically free from leaf diseases, although there is a worm which attacks the straw. It is greenish-white in color, about the size of a pencil lead, possibly a little smaller, and about one-eighth of an inch long. They are usually found in the last node of the straw, and prevent the head from filling. The plants affected are easily

distinguished from the rest by the whiteness and lightness of the heads, which are called "Uban," meaning gray-headed. Very few fields, however, were infected with these worms.

Mice, bats, and birds (mayas) have not done much damage this year. The farmers of this locality have not, so far as I could learn, found any satisfactory way of eradicating or combating these enemies. The majority of the people devote most of their time to fishing, and but little to agriculture, which is a rather lamentable fact, as farming is much more remunerative than fishing.

BALANGA.

The capital of the province has rice, sugar cane, and corn for its principal crops. Rice this year was damaged to the extent of about 20 per cent by too much water in the fields. The disease known as "Uban" is also found here. This disease as explained above, is due to worms which attack the straw. The average yield of rice per cavan of seed is from 35 to 40 cavans, and at the time I visited this place a cavan of rice was selling for ₱2.70, but I was told that at one time this year the price went as high as ₱3.00.

ABUCAY.

Rice is the principal product of this municipality, with sugar cane and corn following. The condition of rice was not so good as in Balanga, Pilar, or Orion. This opinion is based upon what I have seen of their rice fields and the little information which the president of the board of health furnished me.

ORANI.

The same conditions prevail here as in the municipalities mentioned above. Corn and sugar are cultivated but they are secondary in importance to rice. Rice is easily ahead of all other crops, with "macan aga" as the favorite seed of the farmers. Under favorable conditions the maximum yield of rice is 20 to 25 cavans, with an average of 20 cavans, for each cavan of seed.

There is but little difference between the methods employed for the curing of rice here and in Orion. In Orani, instead. of making tall round stacks as in Orion, the stacks are somewhat low and long. As to which of these two methods is the better it is difficult to say, although the low stacks are perhaps easier to make.

DINALUPIHAN.

More than any other place visited in this province, this town depends upon the products of the soil for its subsistence. This municipality is recognized throughout the entire province as the granary of Bataan, there being more rice fields than in any other municipality. Dinalupihan supplies nearly the whole province with rice.

The method of harvesting rice is the same as that employed in the other municipalities of the province; that is, by means of a sickle. The harvesters if men are paid 50 centavos a day, and if women 30 centavos, in addition to which they are given two meals a day. The rice would have been excellent this year but for the late rains, which were very disastrous to the growing crops. Consequently, the harvest will in all probability be only normal, although a large yield was expected; fully one-tenth of the area planted to rice was totally destroyed, and the rest more or less damaged.

The average yield here is 30 cavans for each cavan of seed, a cavan being valued at ₱2.50.

PAMPANGA.

Pampanga as a whole, unlike the Province of Bataan, has sugar cane for its principal crop, with rice only second in importance. The agricultural conditions are also far more advanced than those in Bataan. This is partially explained by the fact that Pampanga is more fortunate in having the railroad, the greatest exponent of commerce, running into every nook and corner of its rich and vast agricultural fields.

FLORIDABLANCA.

This is one of the municipalities which was subjected to the ravages of storms; not less than 20 per cent of its rice crop having been destroyed thereby.

The disease known in Bataan as "uban" is called "menagak" in Pampanga, where it is present to a greater or less extent. No animals or insects have done any damage this year.

The average yield of rice for one cavan of seed is from 25 to 30 cavans, and a cavan sells for ₱2.

GUAGUA.

This is the first town I visited in Pampanga. Sugar cane is the principal product, with rice as a close second. Corn is also grown, but not in sufficient quantities for home consumption. Upon my arrival I found the rice fields all inundated, and I estimate the loss to be greater than in Floridablanca.

The birds ("mayas") bats, mice, and other animals have done but little damage to the crops.

BACOLOR.

Sugar cane and rice are the most important products. Rice suffered considerably from excessive rains. The Rio Grande de Pampanga passes through this place and when it rises the greater part of the rice fields are inundated thus causing much damage.

Of the many varieties of rice grown, "piniling belto" and "dinalaga" are most largely cultivated, being the favorite seed of the farmers. The methods employed in harvesting and curing rice are identical with those

employed in Bataan. The farmers are wide awake and seem to take a great deal of interest in the work of this Bureau. They keep abreast of the times and adapt themselves to changing conditions.

SAN FERNANDO.

This is the thrifty capital of the prosperous Province of Pampanga. Sugar cane and rice are the principal crops, although a little corn is also raised.

Rice in this locality appeared in good condition, but some fields were damaged to the extent of about 20 per cent by water. With water in the field and the plants lodged, the lower layers of the grain being submerged, there was considerable loss caused by the germination and rotting of the grains.

Most of the varieties of rice found in Bacolor are also found in San Fernando with "dinalaga" and "piniling belto" as the principal kinds grown.

ANGELES.

Of the seven municipalities in this province, Angeles is the only one where the rice fields had not suffered to any great extent from floods. The loss here is practically nothing as compared with the other municipalities, which is due mainly to the geographical position of Angeles, it being situated on high land.

Here the rice crop is mostly dependent upon the rain for water, although irrigated fields are to be found near the town and close to the hills, where they utilize the water coming down from the mountain streams.

Three methods of rice planting are practiced in Angeles, as follows: Scattering or sowing broadcast, drilling, and transplanting. The latter method it is claimed gives the best results. They also practice thinning the rice when the plant is about a meter or so high by cutting the leaf stalks and using then as feed for carabaos. They stated that in this way a better yield is secured than when thinning is not practiced.

A few farmers practice the three years rotation of crops by using three varieties of rice. For instance, planting "piniling belto" the first year, "dinalaga" the second year, "lawa" the third year, and "piniling belto" again the fourth year. Those farmers who were using this method declared that the better results were invariably obtained thereby than by continually cultivating one variety, as is done all over the country.

MEXICO.

The principal crops are sugar cane and rice. The rice fields of this municipality suffered more by inundations than all others visited, and the loss is calculated at about 50 per cent of the crop. In this locality I saw people fishing their rice from the water and mud to save it, but of course this rice even after it is dried loses its good cooking and food

qualities. The town greatly needs a good system of drainage. This fact is recognized by the farmers, so much so that most of then have offered to work gratuitously if the government will send then competent engineers to direct the work.

Under normal conditions, the average yield of rice for each cavan of seed is from 20 to 25 cavans, the usual price being ₱2.10 per cavan.

MABALACAT.

The principal crops in this municipality are sugar cane, rice, and corn, in the order given. The rice here suffered damage by water to the amount of from 20 to 25 per cent of the crop. The average yield of rice for each cavan of seed is from 15 to 20 cavans, and a cavan sells at ₱1.75.

The farmers here practice two methods of planting rice, scattering or sowing broadcast and transplanting, the latter giving the best results. A system of rotation as practiced in Angeles is also followed here.

The kind of rice most favored by the farmers of this place is the "macan piña" with "matavia" taking the second place. Besides these two, "lawa," "dinalaga," "piniling belto" and "maiqui" (which means with tail, so called on account of its long awn or beard) are also cultivated.

The farm wage paid here is 50 centavos to men and 40 centavos to women, with two meals a day.

The following varieties of rice have thus far been reported from the towns named in Bataan and Pampanga:

Towns.	Varieties, in order of importance.	Highland (H) or lowland (L).	Glutinous (G) or non-glutinous (NG).	Bearded (B) or not bearded (NB).	Color of cuticle.	Days to maturity	
						From sowing.	From transplanting.
BATAAN.							
Abucay	Macan	H	NG	NB	White	150	130
	Lacatan	L	NG	NB	Red	90	
	In achupal	L	NG	NB	White	180	150
	Inaplaya	L	NG	NB	Red	150	120
	Bulacsac	H	NG	NB	White	150	
	Guinulong	H	NG	NB	Red	150	
Dinalupihan	Macan	L	NG	NB	White	150	120
	Pinursigui	H	NG	NB	Red	90	60
PAMPANGA.							
Macabebe	Pinursigui	L	NG	NB	do	120	80
	Lacatan	L	G	NB	do	180	150
	Calibo	L	NG	NB	White	120	
	Eput-ebun	L	NG	NB	do	120	90
Masantol	Pinursigui	L	NG	NB	do	90	
	Calibo	L	NG	NB	Red	100	
	Lacatan	L	G	NB	do	100	
	Inanis	L	NG	NB	White	100	
San Simon	Macan	H	G	NB	do	210	150
	Macan, San Miguel.	H	G	NB	do	210	150
	Macan, Lamue	H	G	NB	do	210	150
	Eput-ebun	H	G	NB	do	150	
	Pinursigui	H	G	NB	do	90	
	Pauni	H	G	NB	do	105	
	Casubung	H	G	NB	do	150	

EXTRACTS FROM THE REPORT OF MR. R. DERRY, CO-COMMISSIONER FOR MALAYA, ON THE INTERNATIONAL RUBBER AND ALLIED TRADES EXHIBITION HELD IN LONDON, SEPTEMBER 14 TO 26, 1908.[1]

PART I.

The First International Rubber Exhibition was convened with the object of demonstrating the present position of a comparatively new industry and of furnishing an opportunity for its further development by an interchange of ideas between all concerned.

To comprehend the present position of the industry it is well to remember that in 1827, or eighty years ago, the world's demand for raw rubber amounted to fifty tons, and for the year 1907–8 it is computed at 65,000 tons, valued approximately at £20,000,000. As a matter of fact, this enormous industry has been developed during the last fifty years or less, for although there has been a small demand for raw rubber since 1827, real commercial enterprise did not begin until the discovery and perfecting of the process of vulcanization by Goodyear, Hancock, and Parkes about thirty years later. Since that time the demand for raw rubber has annually increased, while some sources of supply have been practically exhausted, and in others the future output is not assured. It should be said, too, that the remaining areas of the world as probable sources of wild rubber are not considerable.

RUBBER-PRODUCING PLANTS.

Until the recent discovery of "guayule" all known rubber-producing plants were included in the four natural orders of *Euphorbiaceæ, Moraceæ, Apocynaceæ,* and *Asclepiadceæ.* The addition of "guayule" (*Parthenium argentatum*) and colorado rubber (*Actinella richardsonii*) introduces another order, viz, *Compositæ.* An addition to the *Asclepidaceæ* is furnished by a new introduction from Angola and Zambesi called "encanda" rubber, and described as *Raphionacme utilis.* There are five other natural orders, of which some genera are said to be lactiferous plants, but they are of theoretical interest only.

[1] From Agricultural Bulletin of the Straits and Federated Malay States, Vol. VIII, No. 2, February, 1909.

The arrangement of the different families of commercial rubber plants is as follows:

I. EUPHORBIACEÆ.—*Hevea, Manihot, Micrandra, Sapium.*

II. MORACEÆ.—*Ficus, Castilloa.*

III. APOCYNACEÆ.—*Landolphia, Funtumia, Carpodinus, Clitandra, Tabernaemontana, Mascarenhasia, Hancornia, Forsteronia, Willughbeia, Urceola, Leuconotis, Melodinus, Parameria, Chonemorpha, Chilocarpus, Dyera, Alstonia.*

IV. ASCLEPIADACEÆ.—*Cryptostegia, Raphionacme.*

V. COMPOSITÆ.—*Parthenium, Actinella.*

RUBBER SOURCES.

The world's output of raw rubber is stated to be as follows:

	Tons.
South America (including Mexico)	43,000
Africa	22,000
Eastern and Indo-Malaya	500
Total	65,000

All of this output is forest or wild rubber. In South America the bulk of the suppy is obtained from Para rubber (*Hevea braziliensis*). Other varieties are, Ceara rubber (*Manihot glaziovii* and *Manihot* sp.), caucho ball, or ule in Mexico (*Castilloa elastica*), Mangabeira rubber (*Hancornia speciosa*), and recently from Mexico "guayule" (*Parthenium argentatum*). The following genera also produce valuable rubber, which is probably mixed with Para: *Micranda, Sapium,* and *Forsteronia.*

The amount of rubber exported from South America during the last fiscal year is said to be 36,000 tons (of this 7,500 tons is caucho ball) by way of Brazil, and about 5,000 tons from Mexico, most of which is said to be "guayule," one-fourth is exported to Europe, principally Germany, and the remainder to the United States.

In Africa the principal rubber-producing plants are several species of *Landolphia,* and Lagos silk rubber (*Funtumia elastica*). Others are the root rubbers *Carpodinus lanceolatus* and *Clitandra henriquesiana.* N'-Harasika rubber tree (*Mascarenhaisa elastica*). Some rubber is also obtained from *Ficus vogelii* and the genus *Tabernaemontana.*

These are widely distributed over tropical Africa. On the west coast from Senegambia, Sierra Leone, Gold Coast, Ivory Coast, Lagos, the Cameroons, Nigeria, Congo, and Gaboon, to Angloa and Benguela. On the east coast from Mozambique, Madagascar, Zanzibar, and Nyasaland to German East Africa. Rubber is also exported from Unganda in the interior. The following trade names indicate the places from which African rubbers are exported: Madagascar niggers, Mozambique ball, Hausa thimbles, Niger cake, Ivory Coast lump, Hausa tail, Benin lump, and others.

The total output of African rubber is stated to be 23,000 tons, which is said to be excessive by some authorities. Of this, 4,800 tons are supplied by the Congo State, about 1,500 tons by the Gold Coast—a considerable shrinkage from previous years—and the balance from other parts of Africa, chiefly Madagascar Mozambique, Uganda, Lagos, Angola, and the Cameroons.

Asiatic or eastern rubbers include Assam rubber—i. e., Malayan Rambong (*Ficus elastica*)—Ferip, Singarip, or Bornean rubber (*Willughbeia sps.*). Other genera are *Leuconitis, Urceola, Melodinus,* and *Parameria.* There are other rubbers, but these do not appear to be included in the usual records and are not mentioned now. At the present time the most important sources of wild rubber are Sumatra, Borneo, and possibly New Guinea. Figures showing the output are given from British India only and are placed at 200 tons.

I would, however, call attention to an important discrepancy between the figures stated to represent the output of Asiatic rubber and the actual exports. It has been ascertained that no less than 10,000 tons of jelutong (*Dyera costulata*) are used annually, which is exported via Singapore and ports to America and Germany. Jelutong is a low grade rubber, but it is of as much importance as the Mexican guayule; indeed, there is strong inquiry for it and I can only suppose the omission occurs because none of the rubber is used in Great Britain.

If, therefore, jelutong is added to the estimated output of wild rubber, the grand total would be 75,000, instead of 65,000 tons.

It should be remarked that this output of 65,000 to 75,000 tons is not only the world's demand but also the world's supply of wild rubber, and at the time of writing the former exceeds the latter, especially for fine grades of rubber, but a change is at hand; already, during the last fiscal year, 1,000 tons of cultivated rubber have been marketed; rubber cultivation is being attempted in the tropics all over the world; the annual output of rubber from plantations in, and coming into, bearing is certain to increase enormously; and a brief review of the economic situation with the aid of observations made at the exhibition may be opportune.

COMMERCIAL RUBBER.

At the exhibition there were thirty countries represented and samples of nearly all commercial rubbers were exhibited for comparison or study. The first impression that would be formed by even a casual inspection was the preponderance of Para over all other rubbers. There could have been an interesting exhibition of Para rubber only, and without it an equally disappointing one. It is, however, very important that the possibilities of all commercial rubbers be examined, and in this review I will leave Para rubber for the last.

I. EUPHORBIACEÆ.

Manihot glaziovii (Ceara rubber) was only sparingly exhibited but the few perfect biscuits and small samples in the Ceylon and West Indies sections received much attention. This species was obtained from the Province of Ceara by Mr. Cross and distributed to the West Indies, India, Ceylon, Africa, and the Straits about the year 1877. Until quite recently all reports in respect to yield were disappointing and its introduction being contemporary with that of *Hevea braziliensis* very little progress had been made. From Africa, the West Indies, and several different countries in the East, reports agree as to luxuriant growth, but a scantly yield of latex. This may be due to excessive humidity or to variety, as there are some favorable reports from southern India, and as there are different varieties of *Manihot,* it may be that most of the Eastern species are of a poor strain, or as said before, that the climate is too damp. Future trials in Malaya would stand the best chance of success if planted at Port Dickson, or the northern part of Province Wellesley.

It should not be forgetten that this rubber when well prepared obtains the highest price. It grows best in dry tropical countries on the poorest soils and if it can be successfully cultivated it will have to be reckoned with as a rubber of the finest grade.

Formerly Ceara rubber appeared on the market in the form of "scrap," being coagulated on the trees by natural heat in tears or strips and subsequently collected and rolled into balls. In this scrappy and impure condition its value naturally depreciated, but the rubber now prepared in India, Ceylon, and German East Africa is valued at about the same as the best plantation Para. The Imperial Institute published the analyses of some samples recently examined. I quote the highest and lowest:

	Highest (per cent).	Lowest (per cent).
Caoutchouc	85.6	82.8
Resin	6.3	8.5
Proteids	6.2	9.4
Ash	1.9	2.3

Other species, perhaps more valuable, are—

Manicoba rubber (*Manihot dichotoma*) and *Manihot piauhyensis* of Brazil. It is believed to be a fine grade of rubber, but native collectors mix the latex with that of *Hevea* and consequently very little is known of its actual value.

Sapium is a genus extending over all the rubber growing districts of Brazil, Colombia, Venezuela, and British Guiana. The latex of a few species in Brazil is used for mixing with *Hevea*. *Sapium biglandulosum,* the most common species in Brazil, has been reported on at different times

and its rejection as a commercial rubber has led to some confusion as to the value of other species; particularly *Sapium jenmani* (touckpong), a native of Guiana and extending to Venezuela and north Brazil. This plant supplies a high grade rubber, but a chemical analysis had not been published at the time of the exhibition. It is anticipated that its cultivation will be taken up extensively in different parts of the West Indies. However, the seedling plants, compared with the robust *S. biglandulosum*, did not impress me as possessing the constitution of a vigorous growing tree for plantations. Other species of value are *S. utile* (palo de leche) from Ecuador and Peru, and *S. verum* (virgin caucho) from Colombia. Price variable, about 3 shillings 2 pence against 4 shillings 6 pence for fine, hard Para.

II. MORACEÆ.

Ficus is an extensive Old World genus, but only a few of the many species produce rubber of commercial value. *Ficus elastica* (Rambong or Assam rubber) is the most valuable species and is now cultivated in India, Ceylon, British Malaya, Java, and Sumatra, but not so extensively as was expected a few years ago, possibly due to the higher price obtained for Para rubber and its more regular yield of latex. This *Ficus* is one of the earliest known of Asiatic rubbers and was first brought to notice by Dr. Roxburgh over a century ago. In a wild state the plant is epiphytic, growing on other trees or rocks, and appears as a small crown or crest of short branches on long rambling aërial roots. Under cultivation it is grown as an arborescent tree and develops stout lateral branches and a consequent larger area of bark for tapping. On some estates in the Netherlands Indies the aërial roots are pruned off and the tree is cultivated as a standard—i. e., a bushy crown and large main stem. Its habitat extends from the Sikkim Himalaya, Assam, and bordering States, to Upper Burmah, the Malay Peninsula, and Sumatra. In habit there are marked varietal types of this species:

(*a*) The Assam type has a straiggling habit with pale green, rather narrow leaves and the yield of latex is only moderate.

(*b*) The Malayan type is of compact habit with larger green leaves (on young trees) and brillant colored stipules. The yield of latex is considerable, provided the period of recuperation is a lengthy one.

(*c*) The Sumatra type resembles the Malayan plant, but is more ornamental in form. The leaves are deep, shining green and more elliptic, and like its Malayan congener the yield of latex is large if not tapped too frequently.

Formerly Rambong rubber appeared on the market in the scrap form only, as the bulk of it does at the present time, but other forms of preparation are forthcoming and improved prices are being obtained. With old trees there is a short flow of latex, followed by slower exudation which coagulates by natural heat in tears and strips on the incisions

made on the tree. This if removed as soon as agglutinated may be boiled and prepared in the form of a biscuit or sheet. On younger trees, there is comparatively a better flow of latex and this can be treated with liquid ammonia, when the particles of caoutchouc, after stirring, gradually separate into a thin layer and can then be skimmed, washed, rolled into biscuits, or passed through a crepe machine and dried.

A long period of rest is necessary, owing to the thick latex peculiar to this tree and the more concentrated form in which the caoutchouc is obtained; but despite this drawback the average yield per tree is probably higher than that of Para rubber and, considering the immunity of the tree from disease, its simple culture and light cost of working, as well as the fine grade of rubber when well prepared, Rambong has many claims for more extended cultivation in British Malaya. At the exhibition the Netherlands' section included sheets, cakes, and in bulk, crude Rambong balls, or rolled scrap pickings bound up with Rambong ribbons obtained by slicing pressed scrap. In the Malayan section Rambong was exhibited in crepe form, but only a few estates were represented. The low price of 3 shillings 8 pence against 4 shillings 6 pence for "fine hard Para" is stated to be due to the small quantity of plantation Rambong on the market. An analysis of well-prepared Rambong compares favorably with that of the best Para, and there is very little difference in respect to caoutchouc but the percentage of resin and proteids is slightly higher.

In Java the Netherlands' Government has rubber plantations amounting to nearly 15,000 acres, mostly of Rambong.

In Africa moderate grade rubber is obtained from *Ficus vogelii.*

Castilloa elastic (ule, Central American rubber, or caucho ball) is a native of Central America, including Mexico, Guatemala, Nicaragua, Panama, Honduras, and parts of Colombia, and when fully grown is the largest of all rubber trees. Owing to excessive tapping, and very often felling, most of the large indigenous trees have been exterminated, but a considerable area in Mexico, estimated at 100,000 acres, is already under cultivation, a factor which must not be lost sight of in considering the future prospects of the rubber market. In the West Indies, too, cultivated *Castilloa* is a rubber which it is expected will be heard of in the future. The yield of rubber from *Castilloa* is high, being about the same as Para and varies from 2 to 16 pounds according to the size and age of the tree. The latex has an acid reaction and can not be cured by smoking. It is generally coagulated by boiling, but sometimes by the addition of alum, salt, or a decoction made from the stems of the moon-flower. A much improved process for coagulating the latex is now used. With the aid of a machine rotating about 6,000 times per minute the particles of caoutchouc are quickly separated into a white layer and can then be taken off and dried. It is expected that all of

the future plantation *Castilloa* will be prepared by centrifugalizing and a better marketable rubber will thus be obtained, as in this way the high percentage of resin can be disposed of. The nerve or tensile strength of *Castilloa* is not so good as that of Para, and the rubber has never obtained so high a price. At the time of writing, caucho ball, dirty scrappy *Castilloa,* is quoted at 3 shillings 10 pence against 5 shillings 4½ pence for fine hard Para.

The attempted cultivation of this species in British Malaya can only be described as a failure.

III. APOCYNACEÆ.

The genus *Landolphia* include several valuable species, the most important being *L. florida* (*Vahea comorensis*), *L. ovariensis* (white rubber vine), and *L. Kirkii* from east tropical Africa.

Other species are: *L. Thollonii,* southern Congo, *L. Buchananii,* east tropical Africa, *L. petersiana,* tropical Africa, *L. senegalensis, L. tomentosa,* west coast, and *L. madagascarensis,* east coast. The *Landophias* possibly occur all over tropical Africa, including Madagascar and Zanzibar. All are climbing plants resembling the Malayan *Willughbeias* and require a post or tree to support the vine or liane, and consequently are not of easy cultivation. The supply of rubber from indigenous plants has considerably diminished owing to excessive and uncontrolled tapping. In German East Africa more control is exercised and worked areas are stated to be closed for a period of three or four years after tapping. Plantations, too, are being formed at the botanic stations of the British African possessions but it is doubtful if these can do more than preserve seeds.

So far, only dirty, badly prepared rubber has been put on the market from Africa and some of this loses as much as 50 per cent in weight when washed. In some parts of Africa the native collectors allow the latex to flow on the ground, where some of the moisture is absorbed or evaporated, and when coagulated the rubber is afterwards gathered regardless of dirt. In other parts the negroes smear the latex over their bodies and when sufficiently agglutinated tear it off and roll it into balls. From the Congo some *Landolphia* rubber is obtained by diluting the latex with water and as the caoutchouc separates it is skimmed off and kneaded into various forms, while at other places on the west coast rubber is prepared by treating the latex with salt water, lime juice, or boiling effusions of certain plants, notably *Bauhinia reticulata.* As may be inferred, much of such rubber is of a very poor grade and obtains only a low price. Some of the best prepared Mozambique ball, probably *Landolphia kirkii,* reached 4 shillings 9½ pence against 5 shillings 4 pence for fine hard Para.

Funtumia elastica (Lagos silk rubber) was first reported from Lagos in 1894. It is widely distributed on the west coast and is also abundant

in Uganda. Unlike the climbing *Landolphias,* to which *Funtumia* is allied, this species forms a medium sized tree and admits of easy cultivation. Its discovery has compensated the African output for the loss of *Landolphia* rubbers through excessive tapping. Some nice samples of clean *Funtumia* were exhibited from the Gold Coast and Uganda, and improved methods of preparation are being carried out in these possessions, but much of the trade rubber is prepared by boiling, a method open to many objections; and the market price of such rubber is about 2 shillings 8 pence, with fine hard Para at 4 shillings 6½ pence.

Carpodinus lanceolatus and *Clitandra henriquesiana* are the so-called rout rubbers. These are semiherbaceous plants found in the Congo and as far as Portuguese southwest Africa and northwest Rhodesia. These little plants grow from 1 to 2 feet high and contain some latex in the leaves and stems, but principally in the creeping underground rhizome. To obtain this rubber the whole plant is removed, the roots are cut into lengths, dried, and afterwards macerated in water for some days, when the caoutchouc can be beaten out, but as the resulting rubber is mixed with particles of the plant such impurities detract from its market value.

Its growth is probably too slow for remunerative cultivation, as it does not appear to be utilized in any one of the many plantations now being formed in many parts of Africa.

Tabernaemontana crassa is a dwarf-growing tree native of Sierra Leone and supplies the rubber from that country and the Gold Coast. This plant is grown in the botanic gardens of the Straits and at Kuala Kangsar, Perak, where it attains the dimensions of a moderate sized tree. The yield of latex is scanty and the percentage of caoutchouc low. Another species of *Tabernaemontana* supplied much of the rubber exported from Madagascar after the *Landolphias* had been exhausted but this, too, in turn, soon largely diminished owing to excessive tapping. A third rubber-producing species, *T. Thustoni,* a moderate sized tree, grows in Fiji and produces some rubber.

Mascarenhasia elastica (N'Harasika or Mgoa rubber tree) a native of British and Portuguese East Africa supplies an addition to the rubber exported from these countries. The annual value of the rubber (including *Landolphia kirkii*) exported from British East Africa averages £20,000. There are a few specimens of this species in the Singapore Botanic Gardens.

Hancornia speciosa (Mangabeira rubber) is a slender-growing tree fairly abundant over nearly all Brazil from Pernambuco to Peru. Unlike the *Haveas* it grows in poor soils and up to an elevation of 5,000 feet. In some parts of Brazil the latex is diluted with water and as the caoutchouc coagulates it is skimmed and dried. At Pernambuco coagulation is obtained by the addition of alum, and in Peru, of soapsuds. In other parts common salt is used for clotting the latex, but with any

of these methods Mangabeira is imperfectly and, in fact, only partially coagulated and frequently ferments giving off an offensive odor; there is also a heavey loss in weight, from 40 to 50 per cent, in washing. There appears to be a fair supply of this rubber, valued at 3 shillings 1½ pence as against 5 shillings 4 pence for standard market grade. No doubt it would be much improved if coagulated by centrifugalizing, as is done with *Castilloa.*

Forsteronia gracilis is a climbing plant, native of British Guinea, north Brazil, and Venezuela. The rubber reported has been of fine grade and the cultivation of the plant in the West Indies is expected. I would, however, again remark that the cultivation of climbing rubbers has not so far met with success. Another species (*F. floribunda*) is found in Jamaica and is also said to produce a fine grade of rubber.

The Indo-Malayan *Apocynaceæ* are well represented by the genus *Willughbeia* (getah gerip, singarip, getah susu, and many other names according to locality). The best rubber is obtained from *W. firma,* formerly common in British Malaya, Sumatra, and Borneo. The rubber is obtained by ringing the liane and the latex drops into folded palm leaves, or native cups, and is coagulated with alum or salt when slightly heated. In this form the rubber is of poor quality, very wet, and loses from 40 to 50 per cent in washing; at the present time it is worth about 2 shillings 9 pence. What is now supplied comes principally from Borneo but the output from all sources has been largely diminished. A few years ago in Malaca and in the Federated Malay States getah gerip or *Willughbeia,* of sorts, was used by the natives for adulterating getah percha and getah taban.

Other species are *W. coviacea, W. tenuiflora,* and *W. flavescens,* the Borneo rubber being a mixture of any or all of these, and probably other rubber vines too. None of these rubber vines have been successfully cultivated. In the wild state the lianes may reach 4 to 6 inches in diameter but under cultivation no such dimensions can be obtained, and even if satisfactory growth could be obtained, I am confident that at the present time such cultivation could not be made remunerative and the superior claim of arborescent trees over climbing plants, for economic working, will commend itself to all parties.

Urceola elastica (getah gerip tembaga and getah gerip merah) is also a climbing plant. It does not grow in Borneo and is now rare in the Malay Peninsula. This was the first rubber plant brought to notice from any part of Asia by Mr. J. Howson, a surgeon of Penang, in 1798. The rubber is of fair grade and of the same quality as *Willughbeia firma.*

Leuconotis eugeniaefolius (akar getah sundi) another climbing plant occurs in the Malay Peninsula, Sumatra, and Borneo. It produce a fair grade of rubber but is now rare. There are two or three species.

Melodinus orientàlis is also a Peninsula climbing plant of only little value. It was formerly used for adulterating the latex of *Willughbeia* and *Leuconotis.*

Parameria glandulifera (akar gerip puteh) and another apocynaceous climber, *Chonemorphs macrophylla,* have a wide Eastern distribution and some repute as rubber plants. A sample of rubber prepared from *Chilocarpus costatus* was exhibited in the Netherlands section from Sumatra.

Dyera costulata (getah jelutong) is a well-known tree in all parts of Malaya, but has only received attention for its commercial value during the last few years. It is a gigantic tree, much larger than *Castilloa.* The writer remembers a tree in Malacca nearly 200 feet high, which at a man's height from the ground required five men with outstretched arms to span its circumference. Locally, the wood although light, is less brittle than *Havea* or *Castilloa* and is used for several bazaar purposes, and by Chinese for wooden sandals. Hitherto, native collectors obtained small supplies for adulterating better grade rubbers and for making a local birdlime. Although the latex contains only a small percentage of caoutchouc, about 5 per cent, a large tree is capable of yielding a considerable volume of such latex; reports place the weight at 2 to 3 pikuls. As previously stated, about 10,000 tons of this rubber are exported annually, principally from Borneo and Sumatra. The bark is of medium thickness, soft, and very easy to excise, and new bark is formed much quicker than with any other rubber tree, hence with ordinary skill and discretion there is no reason why a single tree should be lost through over tapping.

The latex is coagulated by natural heat and evaporation, pressed into balls and cakes, and preserved with the addition of formalin. In this form it has the appearance of a white, spongy cheese and a pungent odor.

It is a huge mistake to suppose that these low-grade rubbers are only used for cheap varnishes or pasting wall papers. I quote from Dr. Wermer Eschs' notes on manufactured India rubber at the recent exhibition. "To-day Para rubber has had to be abandoned so far as the manufacture of a considerable part of our India rubber goods is concerned, and its place has been taken by cheaper rubbers. We have to learn to renounce to a great extent the easy workable Para rubber, and to condescend to take up the wearisome study of the methods of treatment of "guayule." Many have been unsuccessful herein on account of inability to fit themselves into the new conditions and surroundings."

This *Dyera* (jelutong) rubber is similarly used, so I was informed, in Germany, i. e., for compoundings and fillings, as with low-priced goods the best rubbers are prohibited and with some other goods it is claimed that the article is improved by such addition or adulteration.

Owing to its poor grade and low price obtained for jelutong rubber, its cultivation does not attract private enterprise, but considering the demand and the simplicity of conserving or fostering the present trees in the peninsula, the importance of this rubber is worthy of attention.

In Malaya jelutong grows readily everywhere from naturally sown seeds. It may be profitable for reforesting certain areas if seeds can be obtained. These are produced on old, tall trees and are difficult to collect, as when the capsule bursts the seeds, which are flat and thin, are apt to be blown away.

Alstonia scholaris (getah pulai) has a wide distribution from India throughout the tropics of the East. The rubber is not so easily prepared as that of jelutong, but considering the abundance of this tree, particularly in Sumatra, it will most probably soon be in demand. It is fairly common in the Malay Peninsula and is a much smaller tree than *Dyera costulata* but grows from self-sown seeds almost everywhere.

IV. ASCLEPIADACEÆ.

Cryptostegia prandiflora is a well-known plant from Madagascar and is grown in nearly all botanic gardens for its handsome flowers. The rubber is reported as being of fair grade but the cost of collecting it is prohibitive, as the plant is of small dimensions—a bush or low limber.

Raphionacme utilis (Encanda rubber) is a recent discovery from Angola. It differs from all other known rubber plants and is a herbaceous stemless plant with a tuberous shaped root, a tuber like a small garden turnip with a few stemless leaves. So far as is known at the present time the rubber is difficult to separate and prepare. Some laboratory samples show a very high return of caoutchouc but the time and expense of eliminating resins and other matter is considerable. Nearly all the African tubers imply a group of plants peculiar to arid regions. The tuber contains a viscid fluid or storage of sap enabling the plant to survive long periods, two or three years, of drought, and I surmise that it is the difficulty of separating the latex from the contaminating sap of the rubber which detracts from its successful preparation. It is a fascinating plant and furnishes a high grade of rubber, but considering the probable expense of preparation, the uncertainty of a mature crop, and its desert origin, there is little likelihood of its ever reaching the market as plantation rubber.

V. COMPOSITÆ.

Parthenium argentatum (guayule rubber) is a recent introduction from Mexico and Central America. A low herbaceous bush of slow growth, but found wild over large areas of Central America. Although a low-grade rubber it has excited considerable interest in the rubber trade as a cheap adulterant and substitute for better rubbers—thanks

to the advance made in the treatment of all rubbers by chemists and manufacturers—and has brought into use many lines of cheap rubber goods which otherwise would not have been saleable, owing to the high cost of the raw product. The rubber is obtained from all parts of the plat, the bush is cut down, dried and soaked, after which the caoutchouc is beaten out. However, as the whole plant is used, and requires about twelve years to attain a heighth of 2 or 3 feet, its cultivation can not be made remunerative.

It has been suggested that the plants be grown from cuttings or layers; if this could be done, which is very doubtful, there would be a saving of time; but even so, the cost of production would be very high for so low a grade of rubber, and not having any means of quick and successful reproduction, the present wild supply is reported to be approaching exhaustion.

Actinella richardsonii (colorado rubber) is also a composite resembling the "guayule" plant and rubber, but not so abundant.

EUPHORBIACEÆ.

Of the genus *Hevea* (Para rubber) there are said to be fourteen lactiferous species, the most valuable being *H. braziliensis*. This genus has its headquarters in Brazil, but extends to the adjoining territories of Bolivia, Peru, Venezuela, and Guiana. It is the most abundant and best known of all rubber-yielding plants and the prepared product, fine hard Para, is the standard rubber on the market to-day.

With the development of manufactured rubber fears were expressed of the probable exhaustion of wild sources of supply, and the desirability of introducing the Brazilian Para tree to British territory in the tropics, where the natural conditions of climate follow those of Brazil, was first given effect in 1872 when Sir Clements-Markham obtained seeds for the Royal Gardens at Kew. These were taken out to India and in 1875 Mr. Wickham was commissioned to obtain more seeds for the British Indian government. He brought 70,000 seeds to the Kew Gardens and as the climate of India was not considered satisfactory about 1,900 seedling plants were sent to Ceylon. About the same time Mr. Cross was sent to South America for Para plants in case the seeds failed. Mr. Cross brought to Kew living plants and seeds of Ceara rubber and *Castilloa elastica.* The Para plants were distributed to Ceylon, Singapore, and the West Indies. Under experimental cultivation at the botanic gardens of Ceylon and Singapore the trees thrived, but very little progress had been made by planters until the year 1899, when, owing to the collapse of coffee cultivation and the increased price of raw rubber, the prospect of plantation rubber received serious general attention, and at the present time it is estimated that in these two countries alone there are about 360,000 acres under

cultivation, or approximately 60,000,000 plants, raised from the original stock brought by Messrs. Wickham and Cross, and indeed all plantations of Para rubber in the Netherlands, Borneo, Samoa, Burmah, Africa, and the West Indies, are the progeny of plants supplied by the botanic gardens of Ceylon and Singapore.

The price of the best Para rubber advanced from 2 shillings in 1861 to 4 shillings 10 pence in 1882, and fell again to 2 shillings 2 pence three years later. Since then, although there have been fluctuations, the price has gradually advanced, and in 1899 reached 4 shillings 8 pence. About this time (1880–1890) Brazilian collectors discovered that their country was richer in indigenous trees than had been anticipated. All the main tributaries of the Amazon, as far as Bolivia and Peru, offered better collecting ground than the mouths of the Amazon (island rubber), and the port of Para was superseded by the port of Manaos, the capital town of the State of the Amazonas, about 1,000 miles up the Amazon, which is navigable for ocean-going steamers, became, and is still, the largest port for rubber in the world. From Manaos 374 tons of raw rubber were exported in 1880, and 19,924 tons in 1907. Despite this large increase of output, the demand for raw rubber has steadily advanced.

This increased demand is entirely due to the improved methods used by the manufacturers and chemists during the last few years in the treatment of raw material, and a more extended knowledge of compounding, which has brought into the market many cheap goods. Writing on the "Treatment of Rubber," Dr. Torrey says of fillers and compounding: "Substances which make vulcanization take place more promptly and definitely may be added; some of them increase the strength and resilience very notably;" and again, "Compounding is not only defensible, but essential to an intelligent and legitimate application of rubber in the arts."

The rubber produced by the different species of *Hevea* in Brazil is classified, according to the districts where it is prepared, as "fina," "extra-fina," "grossa," and "sernamby," and all of this is coagulated with the aid of smoke. The latex of *Hevea* is alkaline to litmus and the smoke contains the necessary acid reaction, and it is by this process that the best rubber on the market is obtained. It is frequently insisted that the superior quality of "fine hard Para" is due to the particular smoke used, viz, that obtained from the fruit of the urueuri palm (*Attalea excelsa*), but this does not appear to be extensively used, and it is quite possible that the smoke of many other palm-nuts—e. g., coconuts—would answer equally well. The real advantage of smoking most probably lies in the method of coagulation. This was described by Dr. P. Schidrowitz as follows: "The method of smoking and drying one thin layer upon another in endless succession may, in my opinion,

be compared to the manufacture of wirewound artillery. It is well known that the strength of a gun which is built up by tightly winding wire around a core is much greater than that of a solid cast or forged mass. A great part of the physical strength, if I may so put it, of fine Para is due, in my opinion, to this method of coagulation by concentric layers."

No doubt there are other factors than the method of coagulation which enables Brazil to market the finest grade of rubber, and I suggest that the dominant one lies in the short tapping period during the dry season, i. e., at a time when the latex contains the minimum percentage of water.

It is not claimed by manufacturers that "fine hard Para" always reaches the market in perfect condition. It is well known that the latex of several plants is used for mixing with that of *Havea braziliensis.* I was also informed that none of the latex, whether from young or old trees, is kept separate; but it is asserted that any of these difficulties are more easily disposed of with Brazilian than with plantation rubber, where the latex of trees of different ages has been mixed.

PLANTATION RUBBER.

Plantation rubber is still in its infancy and the output compares with Brazilian rubber as follows:

Country.	1905 (tons).	1906 (tons).	1907 (tons).
Ceylon	75	147	248
Malaya	130	385	936
Brazil	34,490	38,000	36,470

It has taken Brazil fifty years to increase its output from 1,800 tons to 36,470 tons and this much may be accomplished by plantation rubber from the East within the next ten years. How far a large influx of cultivated rubber may affect the market, it is difficult to forecast. At the present time there is strong demand for raw material and an annual output of about 100,000 tons during the next decade may not do more than meet market requirements, but there are many other plantations in various parts of the world and when all come into bearing this output would be largely augmented.

But during the next decade there must be a large decrease with several wild rubbers. The African *Landolphias* like the Malayan *Willugbeias* will gradually drop out. "Guayule" is reported to be shortening, and jelutong and pulai in native hands will most probably share the fate of all the other indigenous Malayan rubbers. Whether Brazil can maintain its present output is very doubtful, as there are already signs of a decrease in exports, and Brazil is living on its capital. Un-

doubtedly *Hevea braziliensis* is a marvelously reproductive plant, but there is no record of any plant or crop which does not become exhausted when no assistance in any form is given; the well-known mangrove swamp plant reproduces itself provided seed-bearing trees are ear-marked and the period of recuperation is a long one; but such a system could not be adopted for wild rubber in competition with the plantation product, and the lower grades are almost sure to suffer when cultivated rubbers make good the shortage; I am not at all sure that fine grade Para would suffer by such competition.

RUBBER PROSPECTS.

The greatest injury that could be done to a prospective industry would be to overrate its possibilities, and although cheap production is an important and necessary factor in plantation rubber I suggest that it is a great mistake to build on it as the only or most important one.

It has yet to be proven that the present method of treating latex from plantation Para trees in British Malaya is the best or only method. It will be remembered that the process is borrowed. When Professor Biffen demonstrated the advantage of curing *Castilloa* latex by centrifugalizing he also tried *Hevea* by the same method, but the latex failed to respond to such treatment. The rotating machine was dropped, but the treatment of the latex by diluting with water still remains. There is abundant evidence that water in any form added to the latex of *Hevea* is a mistake. *Castilloa* and *Hevea* are two totally different rubbers, and I suggest that the addition of any water to *Hevea* latex sooner or later polymerises the molecule, and the result is limp rubber. I pause to mention that I was assured by the principal of one of the largest firms of continental manufacturers that different results were obtained from a ball of fine grade Para when treated in Hamburg, Harburg, and Vienna. I wonder on how many estates in the colony or Federated Malay States the water is alike. Para rubber is a highly complex compound and its best method of preparation must of necessity be a common one in order to obtain a uniform standard. It is an immense subject, but I believe, and Mr. Ridley takes the same view, that there is a solution of many of the problems of the treatment of rubber by the process of coagulating with smoke. I carefully inquired from leading manufacturers what they expected or required in plantation rubber, for the manufacturer is the master of the rubber market, and their formula was: "Latex as you get it from the tree without any chemicals, cured by smoking, as is done in Brazil."

Hitherto, owing to the omission of what might appear a trifling detail, we have failed to cure cultivated Para by smoking, but we can do it now, and are doing so, experimentally, at the Singapore Botanic Gardens, and when the novelty of a new process in this country has worn off, we hope

to be able to prepare good marketable samples. Coagulation of latex can be done on films of smoke, but it must be remembered that few plants crop similarly all through the year, and the latex at any given time may be immature as a rubber producer. Hence it by no means follows that this method can be carried on with equal success on trees of all ages and at all times of the year. And, too, the effect of continuous tapping will have to be taken into account. However, investigations are now being made along these lines and we hope to publish the results of these at a later date.

PART II.

Under the presidentship of Sir Henry A. Blake, G. C. M. G., and with careful organization, the exhibition at Olympia proved as successful as it was instructive. In the raw rubber section the countries represented, following the catalogue were: Ceylon, British Malaya, Netherlands, Brazil, Mexico, West Indies, Gold Coast, southern India, Uganda, British East Africa, and Mozambique.

RAW RUBBER.

Ceylon plantations were well represented in their section and the exhibits were nicely displayed around a tastefully designed pavilion. All the rubber was arranged in groups according to the form of preparation without reference to districts; e. g., *biscuit, sheet, crepe, block, scrap* and *worms.* Biscuit and sheet were largely exhibited and were mostly good samples. The Culloden "block" was the most favored exhibit. Ceara rubber, although well prepared, was only sparingly shown, and in fact the Ceylon section consisted almost entirely of Para rubber. This section was well decorated and furnished with a fine series of photographs and maps showing the rubber districts; literature, models of factories, samples of rubber soils and oil, tapping tools, rubber plants, etc.

Crepe.—The difference in color from pale crepe to golden yellow, and from pale to dark crepe, received a good deal of attention by interested visitors. This variation in color, however, probably due to the water, is not so remarkable as the strength of rubber from trees of the same age in different localities, although this is not so easily proved by physical tests as is the case with sheet or biscuit rubber.

Blanket.—Blanket seemed to have a tendency to slightly mold, but the Kamuning exhibit was an excellent sample, and a very fine piece also came from the Linggi Plantations.

Sheet.—Sheet rubber included some interesting exhibits, and when compared with other forms, one wonders if crepe has come to stay. The Singapore Botanic Gardens showed some sheets obtained from old trees, which were not surpassed by any plantation Para. From younger trees a sample of Bukit rajah sheet, was, I believe, the finest piece of prepared Para in the Malayan court. This sample which was of

dark color, moist texture, quite free from mold, (the only sample of sheet in this condition except Caledonia), strong and resilient, received some careful scrutiny. Unlike any other samples of sheet the Bukit rajah exhibit was rolled; the absence of mold, however, was most probably due to careful treatment rather than the method of packing. The Kamuning sheets were bold, but rather wet. Very fair sheet also came from Highlands Cicely, Golden Hope, Vallambrosa, Klanang, and Chang Koon Chang. Good pale colored sheets came from Caledonia, but they were not dry enough; and also from Sungei Choh and Trafalgar, the latter sample being good strong rubber for young trees.

Biscuit.—Biscuits, in comparison with Ceylon, were only scantily staged. The Singapore Botanic Gardens presented some fine instances of strong biscuits, and a very nice, clean, dry parcel was put up for Mr. Tan Chay Yan, of Malacca.

Block.—Block finds favor on a few estates, but of those represented all were dwarfed by the Lanadron exhibit, and possibly no plantation Para at Olympia obtained so much comment and eulogy as this rubber. Unlike Lanadron, all the other block was too dark, and did not commend itself as good commercial samples of Para.

Rambong, like Para crepe, traveled well, being free from mold, and although not largely exhibited, the clean, dry, nice looking samples from Bukit rajah, Consolidated Malay Rubber Estates, Tan Chay Yan, Malacca, and others compared most favorably with the huge lots exhibited by the Netherlands in the form of scrap balls tied with Rambong ribbons.

Literature.—In literature, Mr. Carruthers prepared an account of the industry in Malaya, and Mr. R. G. Walson a pamphlet on the Land Laws and Land Administration of the Federated Malay States, including an appendix showing the cost of rubber cultivation—this pamphlet was much in demand.

The Netherlands section was the most varied of all and although it did not exhibit Para rubber it surpassed all other sections in Rambong, and contained samples of many other Eastern rubbers. Its largest display in raw material occurred with guttas. These were exhibited in many grades and processes showing the advanced stage of the industry. Balata, from Dutch Guiana was well represented, and also gums and dammars from all parts of the Netherlands. The arrangement was tastefully carried out in large pavilions and completed with plans, maps, charts, statistics, instruments, and by far the finest series of photographs, and well printed literature.

Brazilian rubber is not attractive. It was well represented in all the different grades, and the enormous black smoked balls might convey the idea of primitive treatment, but the preparation is a traditional art handed down from the red Indians to the present day Seringuieros and requires a great deal more skill in preparation than is apparent.

The Mexican exhibits were very limited. Some fair-sized living stems of *Castilloa* were shown, and a large lot of "guayule."

From the West Indies, principally Trinidad, small samples of various rubbers were exhibited. These included *Sapium jenmani, Ficus elastica, F. Vogelii, Castilloa, Ceara,* and *Hevea.* In these islands much interest and enterprise in rubber cultivation is now being shown.

The Gold Coast, Uganda, British East Africa, Congo, and Mozambique gave a moderate representation of African rubbers. *Funtumia* and *Landolphias* were on exhibition in the form of "lump," "niggers," "sausage," "ball," "tail," etc., but rubber prepared in this way will scarcely find a market when the plantation product is more abundant. From Uganda and the Gold Coast an effort had been made to get better samples and both countries were represented by tastefully arranged sections.

Reclaimed rubber found a place in the exhibition and its use enters very largely into the trade in manufactured goods.

MANUFACTURED RUBBER.

This part of the exhibition was only moderately represented, manufacturers apparently fearing the possibility of losing or imparting trade secrets, and consequently the extent to which rubber is applied in the arts and manufactures became a matter of conjecture. From the Silvertown Rubber Works, the largest in Great Britain, a varied and interesting series of articles were exhibited, including the history of the tire trade—cycle, carriage, and motor—from the first solid tire to the latest type of the present day. The floor of this section was paved with India rubber tiling of mosaic design. Other exhibits were samples of rubber mats and sheets fifty to sixty years old, ebonite, atletic goods, and gutta-percha cables.

In other sections, balata belting, rubber hose, rubber toys, and surgical, electrical, and engineering goods, were moderately exhibited. Only one exhibit was noticed in the direction of a new use for rubber, viz, as a substitute for tanning. A hide is treated with rubber solution which seals the interstices and renders the hide waterproof and more elastic. It is claimed that all hides so treated are improved in toughness and durability, and rubber-tanned leather would appear to have a future.

MACHINERY.

In this section was exhibited all rubber curing or preparing machines, including washing machines, blocking presses, vacuum drying presses, tools and estate requisites, a model of the Kearney high speed railway, and general estate machinery.

SCIENTIFIC SECTION.

The scientific section included laboratory apparatus and appliances for testing and analyzing rubber and rubber goods, and scientific instruments.

Literature was adequately represented by the technical journals of England, America, France, Holland, and Germany, and books dealing with every branch of the industry were abundant.

From the Royal Gardens at Kew an interesting group of rare and new rubber specimens and samples was shown, as well as two Wardian cases of Para seedlings, packed in the same way as in 1876, when the first plants of *Hevea braziliensis* were sent to the East.

CONFERENCES.

During the exhibition conferences were held by the delegates from nearly all Europeans countries and America, and a very full and complete program of the industry in all its phases was gone through.

CONCLUSION.

It is proposed to hold another exhibition in London two years hence, or in 1910, which speaks well for the success of the first International Exhibition. That success was largely if not entirely due to the development of cultivated rubber, which, as was acknowledged by the American and continental delegates, owes its position to British enterprise.

AGRICULTURE IN MANCHURIA.[1]

By Frederick D. Cloud,
Vice-Consul-General at Mukden, Manchuria.

Reports from all quarters indicate that the year 1908 has been an unusually prosperous one for Manchurian farmers. Especially is this true as regards the farmers of Shengking Province, where the crop yield is stated to be 20 per cent greater than the average for each year. The general range of prices for all farm products is also somewhat above the average, to the great delight and profit of the agricultural classes.

The government of this province has supplied me with a few statistics which I have converted into American values, enlarged from independent sources of information and arranged in a manner that may be of some value to those interested in the present and future of Manchuria as a market for foreign imports. The Manchurian Government is making a serious effort to inaugurate a system for the compilation of vital statistics of all kinds, and the following statistics are based on data furnished by its new Bureau of Statistics.

According to these figures therefore, the total population of Shengking (Fengtien) Province is 10,312,211, of which number 2,520,145 are engaged in agriculture.

Acreage under cultivation.—The total area under cultivation in the province is 4,333,333 acres, that is, there are 1.72 acres of tilled land per capita of the farming population. This of course does not mean that the average-sized farm contains only 1.72 acres, for it is well known that farming is carried on in many cases by the family or clan, which may contain from five to fifty people, who work together on one common farm, sharing the proceeds according to their own private arrangements. Such a farm might and often does comprise a hundred or more acres. No accurate data are available as to the average size of a southern Manchurian farm, but it is not far wrong to put it at 12 acres. This would make the average rural family number seven persons, which is approximately correct.

Land tenure.—Freeholding is the rule throughout Fengtien Province, but there is also considerable tenancy, the land being leased from (1) the Government, (2) Manchu princes, and (3) Lama priests. In the

[1] **Extract from "Far Eastern Review, Vol. V, No. 9, Feb., 1909.**

case of Government lands, the terms of lease are such as to make the tenants virtual owners, the leases being in perpetuity and the tenant having to pay only a very nominal annual rental. To this class of land belong the large tracts of "banner land" set aside in times gone by for the use and maintenance of soldiers' families. These soldiers belonged to regiments or corps known as "banner corps," hence the term "banner land." Likewise, in the case of large tracts owned by the Manchu nobility, leases are given in perpetuity, but for this class of land the tenant must pay a higher rental than for Government land. Land owned by the Lama priesthood, of which there is a considerable amount scattered throughout the province, is leased on long or short terms, and the rental paid therefor is usually the highest of that for any land. The rental for this land ranges from 6 to 15 bushels (1 bushel equals 60 pounds) of beans to the acre, which at present prices and exchange would amount to from \$3.30 to \$8.25 per acre.

Grain.—The following table shows the principal varieties of grain produced, together with beans, and the value and production per acre of the different crops;

Name.	Average production per acre (bushels).	Average value per acre (U. S. gold).	Average value per English bushel of 60 pounds (U. S. gold).
Kaoliang	35.3	\$11.95	\$0.34
Beans	31.6	17.35	0.55
Wheat	23.3	16.49	0.71
Maize (corn)	23.3	7.89	0.34
Barley	28.0	12.48	0.44
Millet	20.3	9.31	0.44

The following table indicates the approximate acreage devoted to each crop, together with the total amount of each and the approximate total values thereof:

Name.	Approximate acreage per annum.	Approximate total production, 1 bushel = 60 pounds.	Approximate total value per annum.
Kaoliang	2,166,666	76,526,643	\$26,019,059
Beans	1,300,000	40,716,000	22,393,800
Millet	433,333	9,099,993	4,003,997
Wheat, Barley, Maize, Tobacco, Garden truck, etc	433,334		3,900,006
Total	4,333,333		56,316,862

Kaoliang.—As shown by the above table kaoliang (*Sorghum vulgare* Pers., Barbadores millet) is the most extensively grown and the most valuable crop, while the soy bean is second. Kaoliang is the food staple

of Manchuria, and bears the same relative value in the food economy of Manchurians that rice does in that of southern Chinese, or wheat in that of the Anglo-Saxon. Its uses are manifold, for besides furnishing the greater portion of the Manchurian's daily food, it supplies an alcoholic drink, thatching for houses and barns, matting for summer sheds and winter floors, wind-breaks to shield the farmer's household from the icy blasts of winter, and fuel to cook his food and warm his house. No part of the kaoliang plant is allowed to go to waste. Even the stubble and roots are carefully pulled up, dried and put away for fuel. The green blades also are gathered just before the grain is fully ripe, tied in bundles and stored for winter fodder for the donkeys and cattle.

A kaoliang field, after the crop has been harvested, is absolutely bare, there being nothing left of the vegetation to reënter the soil, and herein lies the chief, and practically the only objection to the continuous cropping of kaoliang. It requires much from the soil, but gives back nothing in return.

Soy bean.—The soy bean on the other hand is a good soil fertilizer and is extensively grown throughout the province, especially in the rich valley of the Liao River. The bean is the greatest of all export crops from Manchuria and can always be relied upon to afford the farmer ready cash. Bean oil is used throughout China for culinary purposes, being employed as lard is used in American households, while the residue after the oil has been expressed (bean cake) is exported mostly to Japan, where it is used for fertilizer. The exports of bean cake from China during 1907 amounted to 278,801 tons, and were valued at $7,300,000, United States currency, or $26.18 per ton of 2,000 pounds. During the same period there were in addition 89,124 tons of beans exported, valued at $2,560,790, or at the rate of $28.73 per ton. The total value of China's bean crop exports for the year 1907 was, therefore, $9,860,790, the greater part of which was produced in southern Manchuria.

Manchuria has a great advantage over most other agricultural regions in that the soy bean can be grown most successfully throughout the entire region, from Dalny on the south to Harbin in the north. In the United States, on the other hand, this crop is not grown with much success outside of what is known as the "cotton belt."

Millet.—The crop that ranks third in importance in the province is millet, of which there are several varieties. The best of these are known as Japanese millet, and are grown mostly for human food. It is a hardy crop and highly valued by the farmer for home consumption, but little is produced for foreign export. The annual crop is valued at about $4,000,000.

Wheat.—The wheat crop of the province has not as yet become large, but is important in view of the growing tendency among all classes to

replace the native cereal foods with wheaten cakes and bread. Thus far but little attention has been devoted to wheat growing, but with the advent of modern flour mills in Manchuria, of which there are several in operation and more being constructed, the native farmer is devoting his thought to wheat production. There is no reason, as far as soil and climate are concerned, why the Province of Shengking should not produce vastly more than enough wheat for the consumption of its entire population. At present, the native farmers know practically nothing about the proper selection of seed, or of the proper methods of cropping, harvesting, and marketing of wheat. The flour mills now in operation complain very bitterly about the Manchurian farmer's methods of harvesting and marketing his wheat. The varieties of wheat grown and the quality of the berries are very fair, and would make a good medium grade flour, if the farmer would only care for his crop in the right way. But this, apparently, he will not do, for when the wheat comes to the mill, it is either musty, or weather bleached, or foul, from which it is impossible to make a good grade of flour.

Until, therefore, the Manchurian farmer gives more intelligent attention to the seeding, harvesting, and marketing of his crop, wheat-growing will remain practically where it is, and as a crop wheat will continue to be of minor importance.

Corn (maize).—Corn is grown to some extent throughout the province, the Liao Valley, to the east of Liaoyang, affording perhaps the greatest area devoted to this crop. At present the crop is of but little value owing to defective methods of seed selection, planting and cultivation. The soil and the climate, however, of southern Manchuria, especially throughout the fertile Liao Valley, is without doubt naturally adapted to the abundant production of Indian corn. The rich alluvial soil, together with the long, hot, summer days, and warm nights, combined with copious showers of rain, constitute ideal conditions for the successful production of corn. With good seed and intelligent cultivation, there is a little doubt but that Indian corn could be made a more profitable crop to the farmer of Southern Manchuria than either kaoliang or the soy bean.

Sugar beet.—The loose, loamy soils of Manchuria are particularly well adapted to the growing in great abundance of all kinds of root crops, and are especially favorable for sugar beet production. The intense summer sunshine not only gives an abundant yield of roots, but produces a high percentage of sugar. Tests made last season at the local experiment farm showed amounts of sugar ranging from 14 to 18 per cent.

A large German beet-sugar concern recently sent an expert from Germany to look into the possibilities of the beet-sugar industry in Manchuria. According to my information, his report was most favorable, but whether or not the company contemplates the establishment of a

factory in Manchuria is unknown. At Harbin, however, such a factory is being installed.

In view of the rapidly growing demand throughout China for refined sugar, there are undoubtedly great possibilities in the beet-sugar industry in Manchuria.

Fruits.—There are but few varieties of fruit grown in the province, among which the pear, grape, and persimmon are the most valuable. The pears are hard and watery, and while they are good keepers, lasting from season to season, they are not a good table pear. Grapes are grown extensively and are the most satisfactory of all the Manchurian fruits. There is, practically, but one variety of this fruit, which resembles the California red wine grape. It is not a first-class table grape, but as it can be kept through the winter and until spring, it is, as before stated, the most satisfactory of all the Manchurian fruits. The large red persimmon is also grown and is much prized by the Chinese. Because of its abundance, it is the cheapest of all the fruits and constitutes almost the sole fruit diet of the poor classes.. Besides the fruits mentioned, there are apples, peaches, and plums of poor quality and of no great abundance. Apricots, also of inferior quality, are scatteringly grown among the hills in the southern part of the province.

The inhabitants of Manchuria are exceedingly fond of fruit, but curiously enough they seem to take little or no interest in fruit growing. If a tree grows up of its own accord and bears fruit, well and good, but the native has neither sufficient knowledge nor the disposition to care for it and cultivate it along approved lines. There is no doubt but that great quantities of excellent fruits could be grown in various parts of the province, if only intelligent methods of selection, budding, and cultivation were employed. The striking success which has followed the efforts of American missionaries in Shantung Province to improve native varieties by introducing scions from American fruits, is indeed worthy of emulation in Manchuria. The Chefoo apples, pears, and grapes are now sold in nearly every treaty port of China and command prices second only to fruits imported from America.

Live stock.—The following table shows the principal kinds of live stock of the province, the approximate number and total values of each kind, and the average value per head:

Kind.	Number.	Value.	Average value per head.
Horses	124,008	$1,525,298.40	$12.30
Cattle	62,060	588,892.00	8.20
Mules	124,242	1,780,844.00	14.33
Hogs	1,925,260	4,736,139.60	2.46
Total	2,235,574	8,551,174.00	

In addition to those mentioned, there are said to be upward of 600,000 head of sheep and goats, valued at about $1,026,148. So that the total value of the province's live stock is $9,577,322. This is indeed a nominal figure in comparison to what it might be with consistent and intelligent breeding.

It is a well-known fact that the Manchurian farmer, just as with fruits and grains, takes no pains and gives little thought to the breeding of his domestic animals. His hogs have the run of the farm, breed when they like, and subsist the best they may from kitchen and other refuse. The result is exactly what might be expected, a large-bellied, long-nosed, long-haired, loose-jointed beast, compared to which the aboriginal "razor-back" of the Ozark Mountains is a well-bred animal. Yet, as shown by the above table, the province produces annually 1,925,000 head of these animals. Scarcely any greater attention is bestowed upon the breeding of cattle or horses. Indeed, a vast majority of the horses and cattle of the province are brought down year by year from the plains of Mongolia, where the only occupation of the people is stock raising, and while the Mongolian pony is an excellent work animal, he is small and poorly bred.

In animal breeding, as in general farming, a little intelligent selection and care would greatly increase the farmer's net profit.

Farm labor.—According to information supplied by the Bureau of Statistics above referred to, the average wage paid to farm hands ranges from 12½ to 17 cents per day, or from $3.75 to $5 per month. Wages vary, however, in different parts of the province, also with the different seasons. For instance, during the harvest season transient labor from Shantung is paid as much as 28 cents (70 cents silver) per day, while at other seasons labor may be had for from 8 to 10 cents per day. Most of the farm labor of Manchuria comes each year from Shantung, Chihli, and Honan, and with the approach of winter returns to its provinces.

The Manchurian Government has recently offered to grant free transportation to all the people of Shantung, Honan, and other provinces who were willing to emigrate to the three eastern provinces and cultivate the untilled lands of Manchuria.

Land values and taxation.—The average value of agricultural lands, according to the statistics above referred to, ranges from $8.40 to $12.30 per acre for first-class land and from $5 to $7.50 per acre for second-class. The general average value per acre, therefore, would be $8.30. This appears to be an exceedingly low average, but it must be remembered that the values quoted are in United States currency, $1 of which is equal at the present rate of exchange to $2.50 in Manchurian currency, and that the cost of living, as between the inhabitants of Manchuria and Americans, is roughly in the ratio of 10 to 1, *i. e.*, where it costs the American equivalent of 10 silver (Mexican) dollars to live, the Manchurian will get along, in his way, on 1 silver dollar.

In the matter of taxation it is impossible, from the meager information obtainable, to make a statement which would even approximate the facts.

There are land taxes, grain taxes, a salt tax, an opium tax, a tax per head on beef cattle and sheep, a butcher's tax, an export tax, a police tax, a school tax, etc. Certain of these taxes are fairly uniform throughout the province—*e. g.*, the salt tax—but in the main, they vary with each magistracy, according to the needs of the particular district or the caprice of the tax collector. The authorities never make public the state of the provincial or district revenues, neither the amount required per annum nor for what purposes the money is spent. Systematic and uniform taxation, coupled with the compilation and publication each year of financial budgets, would do much to correct many of the administrative evils which encourage deception and fraud in the payment of Government revenues and retard progress.

Agricultural development in Manchuria.—Prof. Edward C. Parker, of the University of Minnesota, who was recently employed by the Fengtien Government to establish an agricultural college and experiment station at Mukden, writing on the subject of agricultural development in Manchuria, says:

It is the opinion of the writer that the chief problems of agricultural development in Manchuria at the present time are economic, social, and political problems, rather than scientific problems relative to the stimulation of greater productiveness in the soil. The vast acres of uncultivated land in the north are capable of producing a surplus crop for export even with crude methods of soil tillage, if transportation facilities could be developed to bring the farmer in touch with world markets. The agricultural problem of Manchuria is not so much the problem of making two blades of grass grow where one grew before, as to change the existing economic and social conditions of farm life into an advanced condition of commercial agriculture in which the farmer can produce a surplus of food above local demands and find a ready cash market for that surplus. While improved methods of agriculture are undoubtedly necessary if the Manchurian farmer is to produce a large surplus for export, it is still more necessary that there be a market and a means of reaching that market with the surplus crop. If good roads could connect with railways and waterways in Manchuria, and if capital could organize the facilities for storing and shipping staple agricultural products into every community, there is little doubt that Manchuria would produce a large surplus of crops for export, and in striving to produce a surplus the farmer would be quickened and fully awake to the advantages of improved methods of agriculture. The Manchurian farmer is not so much in need of the agricultural teachings of European and American applied science as he is in need of the far-sighted genius of such men as James J. Hill in the United States, and Shaughnessy in Canada, who built the steel paths of commerce into the fertile fields of North America and were content to wait for dividends until the settlers came in and opened the soil. To-day every farming community in America is in touch with the world markets, and being in possession of markets the agricultural problem of America is to increase production by the application of science to the art of agriculture. One hundred years ago the American farmer produced his food, fuel, and clothing on the land and exchanged very little of his crop for cash. Then as transportation facilities developed, and the inventive

genius of the American applied mechanical principles to agriculture, the old system of "produce-and-consume-what-you-produce" farming passed away and crop products are now exchanged for cash, and the farmer buys coal for fuel and factory goods for his clothes. The Manchurian farmer of to-day is in a stage of civilization more remote from the highest modern civilization than the American farmer of one hundred years ago, and this fact must be realized in considering any Government policy for the improvement of agriculture.

The Chinese character seems to lend itself to the adoption of new methods from demonstration rather than from reading or oral teaching, and thus in formulating plans for improving conditions in Manchuria the work of demonstration should have an important place. Government demonstration and experiment farms should be established in all the important regions of Manchuria and efforts be made to interest the farmers in simple machines such as plows and seed drills and in better methods of cultivation, in anticipation of the time when better markets for the surplus crops of Manchuria may develop. Such machines as the two-horse American plow are within the reach of the common people, and I am convinced that the people would be interested in such machines if they had the opportunity of witnessing their work.

The potential wealth of Manchuria lies to a far greater extent in the soil than in either timber or minerals, and should Manchuria ever be developed to its full possibilities its products both in quantity and quality would be as famous in the world's markets as the wheat of Canada and the cotton, corn, and beef of the United States. Manchuria is a country of tremendous agricultural possibilities.

AGRICULTURAL NOTES.

Weather conditions.—Notwithstanding the excessive rains in some provinces, excellent crops have been reported from San Jose, Nueva Ecija, and Candijay, Bohol. From last reports there was every indication of excellent crops of corn and tobacco at Carcar, Cebu; of hemp and coconuts at Luzurriaga, Oriental Negros; of maguey at Corella, Bohol, and Medellin, Cebu; of corn at Maasin, Leyte, Daui, Bohol, and Danao and Bontoyan, Cebu; of rice at Ligao, Albay; of sugar cane at Tadela, Cebu, Maragondon, Cavite, and Murcia. Occidental Negros; and sugar cane and maguey at Cabancalan and Talisay, Occidental Negros, Ibaan, Batangas, and Porac, Pampanga.

In San Pablo, Laguna, large quantities of coconuts were harvested, and a great deal of rice in the Provinces of Bulacan, Leyte, Tarlac, and Occidental Negros. In the municipalities of Leyte, Lepanto-Bontoc, Ilocos Norte, Ilocos Sur, Sorsogon, and Union, the corn, rice, and tobacco crops had every indication of giving satisfactory returns.

The rains and typhoons of the last rainy season, while they did a great deal of damage in some municipalities of Ambos Camarines, Albay, Sorsogon, and Samar, were in many places favorable to the development of growing crops, such as hemp and palay, so that, relatively speaking, little damage was done, aside from that occasioned by the typhoon of September 23 on the Island of Masbate and in the surrounding sections, where in some places practically all of the crops were destroyed. On the Island of Masbate some towns were almost entirely wiped out; in one instance only three houses were left standing in the town.

Droughts, which, however, were not serious, have been reported from Pinamungahan, Cebu; Sevilla, Bohol; Bato, Ambos Camarines, and several other localities.

In a number of places where there were no irrigation facilities, particularly on new plantations, the crops suffered from lack of water. This was so in the case of palay in Catarman, Samar, and Antequierra, Bohol. Corn and tobacco have also suffered from the same cause.

Rats.—In some municipalities of the Provinces of Rizal, Pangasinan, Albay, Ambos Camarines, Cebu, Bohol, Oriental Negros, Agusan, and the Moro Province, an unusual visitation of rats has done serious damage to the corn and palay crops. In Albay and Ambos Camarines their ravages seem to be worse than in other provinces, and Mr. David B. Mackie, agricultural inspector of this Bureau, was sent to investigate conditions and inaugurate a campaign against these pests. Mr. Mackie is devoting

all of his time to this work and it is expected that he will be able to obtain information as to the best methods of their destruction in the other provinces.

Worms, insects, and locusts.—In some provinces more or less damage has been done to the growing crops of rice, corn, coffee, and tobacco, by insects. Bataan and Pampanga report the presence of an insect borer which whitens the rice heads and prevents them from filling. This condition is called "uban" in Bataan and "managak" in Pampanga. An insect borer called "carcona," and a flying insect called "danguoo" were reported as having caused the loss of at least one-third of the rice crop in some towns of Pangasinan.

In Himamaylan, Occidental Negros, it is reported that the growing sugar cane has been somewhat damaged by flights of young locusts.

Animal diseases.—Rinderpest has appeared in different places, among others, at San Jose, Ambos Camarines, where it is supposed to have been introduced by cattle imported from Carmaon. Dr. H. A. Forrester, of Legaspi, immediately inoculated all of the animals exposed to contagion and placed both municipalities under quarantine. No further complaints have been received and it is believed that the disease is practically stamped out in this locality. Rinderpest also appeared in Guinan, Samar, Larena, Siquijor, and Inopacan, Maasin, and Palompon, Leyte. In most places, however, the disease seems to be disappearing and the inoculations made by the veterinarians of this Bureau have given very satisfactory results. In some places the disease developed largely because of lack of precaution on the part of owners failing to properly isolate infected cattle.

Foot-and-mouth disease has existed in a few municipalities, but generally speaking, it appears to be gradually decreasing and conditions are very much improved.

Harvests.—The Province of Tarlac has produced the best rice harvest during the past season, and following in order come the Provinces of Albay, Occidental Negros, Pangasinan, Ilocos Norte, Laguna, Zambales, and Ambos Camarines.

In the production of coconuts, Laguna stands first, and following it are Tayabas, Bohol, Samar, Cebu, Ambos Camarines, and Albay.

The production of hemp has not been as large as usual in many places owing to the prevailing low prices. However, Laguna, Albay, Sorsogon, and Samar have raised large quantities.

Cebu, Bohol, and Occidental Negros have raised the largest quantities of corn, while Occidental Negros, Batangas, Ilocos Norte, and Pangasinan have led in the production of sugar.

The last reports on the tobacco crop show that Cagayan, Union, Iloilo, Panay, and Ilocos Sur have produced satisfactory quantities. Other provinces have done well, although the amount produced has not been large.

CROPS PLANTED AND HARVESTED AND CONDITION OF SAME TAKEN FROM MONTHLY CROP REPORTS FOR THE MONTH OF JANUARY, 1909.

[RICE.—Attention is invited to the fact that rice should be understood as being in the unhulled state.]

Province and crop.	Condition.	Planted during month.	Harvested during month.		
			Hectare.	Quantity.	Unit.
Agusan (reports from 2 towns):		*Hectares.*			
Rice	Fair	10		175	Cavans.
Abaca	Good			575	Piculs.
Corn	do			200	Cavans.
Coconuts	do				
Albay (reports from 10 towns):					
Abaca	do	52	7,403	13,374	Piculs.
Coconuts	do			704,300	Nuts.
Corn	do	176	35	320	Cavans.
Rice	do	28	130,425	396,800	Do.
Ambos Camarines (reports from 20 towns):					
Rice	Fair	1,000	10,127	43,259	Do.
Abaca	Good	246	2,969	8,565	Piculs.
Coconuts	do			1,102,300	Nuts.
Sugar cane	do	22	19	22	Piculs.
Antique (reports from 6 towns):					
Sugar cane	do	124	96	2,860	Do.
Coconuts	do			60,000	Nuts.
Abaca	do		9	49	Piculs.
Cacao	do		6	25	Arrobas.
Bataan (reports from 5 towns):					
Sugar cane	do	5	9	540	Piculs.
Corn	Fair	35	29	330	Cavans.
Rice	Good	10		1,126	Do.
Abaca	do				
Batangas (reports from 12 towns):					
Rice	do		535	15,420	Cavans.
Sugar cane	do	357	423	11,800	Piculs.
Corn	do	243	395	4,295	Cavans.
Abaca	Fair		11	12	Piculs.
Benguet (reports from 9 towns):					
Coffee	do		16	110	Arrobas.
Rice	Good	63	3	60	Cavans.
Sugar cane	Fair			19	Piculs.
Bohol (reports from 26 towns):					
Coconuts	Good			1,571,000	Nuts.
Abaca	do	84	180	402	Piculs.
Corn	Fair	945	1,383	6,065	Cavans.
Rice	do	920	724	3,498	Do.
Bulacan (reports from 12 towns):					
Rice	Good	4,628	960	36,000	Do.
Sugar cane	do	918	85	780	Piculs.
Corn	do	92	10		
Tobacco	Fair	10			
Cagayan (reports from 11 towns):					
Corn	Good	716	2	100	Cavans.
Tobacco	do	2,240	3	100	Quintals.
Rice	do		339	4,906	Cavans.
Sugar cane	do	8	2	5	Piculs.
Capiz (reports from 14 towns):					
Abaca	Fair	15	42	125	Do.
Coconuts	do			56,000	Nuts.
Tobacco	do	175			
Sugar cane	Good	25	55	946	Piculs.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of January, 1909—Continued.

Province and crop.	Condition.	Planted during month.	Harvested during month.		
			Area.	Quantity.	Unit.
Cavite (reports from 5 towns):		*Hectares.*			
Rice	Good		4,785	8,250	Cavans.
Corn	do	5	12	150	Do.
Abaca	do		50	100	Piculs.
Sugar cane	do	26	80	2,400	Do.
Cebu (reports from 29 towns):					
Coconuts	do			1,109,046	Nuts.
Corn	Fair	1,472	16,350	158,337	Cavans.
Rice	Good	121	425	4,800	Do.
Sugar cane	do	277	314	3,553	Piculs.
Ilocos Norte (reports from 7 towns):					
Rice	do		8,893	178,820	Cavans.
Sugar cane	do	323	226	674	Piculs.
Tobacco	do	70	40		
Maguey	do	122	35	100	Do.
Ilocos Sur (reports from 20 towns):					
Corn	do	1,288	52	365	Cavans.
Tobacco	do	251			
Sugar cane	Fair	387	441	3,277	Piculs.
Rice	do		4,324	23,040	Cavans.
Iloilo (reports from 9 towns):					
Rice	Good		2,710	37,810	Do.
Abaca	Fair	465	72	356	Piculs.
Sugar cane	Good	57	167	4,095	Do.
Corn	do	1,068			
Isabela (reports from 2 towns):					
Tobacco	Fair	200			
Corn	do	50			
La Laguna (reports from 16 towns):					
Abaca	Good	8	384	206	Do.
Coconuts	do			6,939,000	Nuts.
Rice	Fair	401	4,232	102,500	Cavans.
Sugar cane	do	100	312	2,050	Piculs.
La Union (reports from 10 towns):					
Tobacco	Excellent	1,145			
Coconuts	Good			45,500	Nuts.
Sugar cane	do	91	75	823	Piculs.
Rice	Fair		3,051	12,200	Cavans.
Lepanto-Bontoc (reports from 14 towns):					
Rice	do	221	583	9,721	Do.
Corn	Good	15	94	473	Do.
Sugar cane	Fair	1	27	202	Piculs.
Tobacco	Good	182	130	100	Quintals.
Leyte (reports from 15 towns):					
Rice	do	3,924	771	25,080	Cavans.
Abaca	do	22	3,617	15,643	Piculs.
Corn	Fair	244	118	582	Cavans.
Coconuts	Good			554,907	Nuts.
Mindoro (reports from 1 town):					
Abaca	Fair	10	100	200	Piculs.
Coconuts	do			12,000	Nuts.
Corn	do		25	25	Cavans.
Misamis (reports from 4 towns):					
Rice	Good		60	1,800	Do.
Coconuts	do			276,342	Nuts.
Corn	do	80	62	690	Cavans.
Abaca	do	35	115	700	Piculs.
Moro Province (reports from 4 towns):					
Rice	do	2	150	7,000	Cavans.
Coconuts	do			158,159	Nuts.
Sugar cane	do	80	2	1	Picul.
Corn	do	5	10	205	Cavans.
Nueva Ecija (reports from 17 towns):					
Rice	Fair		11,006	375,650	Do.
Sugar cane	do	68	99	640	Piculs.
Tobacco	Good	152			
Corn	do	38	52	8	Cavans.
Nueva Vizcaya (reports from 4 towns):					
Rice	do				
Coconuts	do			96,000	Nuts.
Sugar cane	Fair				
Corn	do				

Crops planted and harvested and condition of same taken from monthly crop reports for the month of January, 1909—Continued.

Province and crop.	Condition.	Planted during month.	Harvested during month.		
			Area.	Quantity.	Unit.
Occidental Negros (reports from 15 towns):		*Hectares.*			
Sugar cane	Good	6,477	13,610	255,475	Piculs.
Rice	Fair	2	2,820	71,960	Cavans.
Coconuts	Good			205,530	Nuts.
Corn	do	181	344	82,010	Cavans.
Oriental Negros (reports from 14 towns):					
Sugar cane	Fair	46	82	2,405	Piculs.
Rice	do	6	218	2,480	Cavans.
Coconuts	Good			844,500	Nuts.
Corn	Fair	73	347	3,810	Cavans.
Pampanga (reports from 8 towns):					
Sugar cane	Good	2,645	1,690	2,680	Piculs.
Corn	do	170			
Rice	do	1,270	2,150	4,000	Cavans.
Pangasinan (reports from 28 towns):					
Rice	do		17,785	243,836	Do.
Coconuts	do			384,864	Nuts.
Sugar cane	Fair	172	886	5,090	Piculs.
Corn	Good	183	131	606	Cavans.
Rizal (reports from 13 towns):					
Abaca	do				
Sugar cane	do	11	112	22	Piculs.
Rice	Fair		3,500	3,500	Cavans.
Corn	do	50	13	225	Do.
Samar (reports from 21 towns):					
Rice	do	1,951	196	2,672	Do.
Abaca	do	135	1,592	5,876	Piculs.
Coconuts	do			1,290,270	Nuts.
Sugar cane	do	36	57	125	Piculs.
Sorsogon (reports from 15 towns):					
Rice	do	1,259			
Abaca	do	656	7,557	11,499	Do.
Coconuts	do			39,300	Nuts.
Sugar cane	do	14	61	27	Piculs.
Surigao (reports from 2 towns):					
Rice	Good	300			
Abaca	do		30	100	Do.
Coconuts	do			5,000	Nuts.
Sugar cane	Fair	2	1	5	Piculs.
Tarlac (reports from 11 towns):					
Rice	do	202	73,196	717,155	Cavans.
Sugar cane	do	1,452	3,933	4,311	Piculs.
Tobacco	do	129			
Corn	do	3			
Tayabas (reports from 13 towns):					
Corn	Good	45	11	110	Cavans.
Rice	do	4,776	10		
Abaca	do	3,668	149	369	Piculs.
Coconuts	Fair			3,236,800	Nuts.
Zambales (reports from 8 towns):					
Coconuts	Good			23,000	Do.
Sugar cane	do	37	100	788	Piculs.
Corn	Fair	7	5	250	Cavans.
Rice	Good		3,403	82,375	Do.

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Highest, lowest, and average of rice, abaca, copra, sugar, tobacco, and corn for the month of January, 1909.

Province.	Rice, unhulled, per cavan.			Abaca, per picul.			Copra, per picul.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Agusan	₱3.00	₱2.00	₱2.50	₱7.00	₱7.00	₱7.00	₱5.00	₱5.00	₱5.00
Albay	3.65	1.75	3.60	8.50	5.50	6.31	7.00	4.25	5.96
Ambos Camarines	4.00	1.50	2.89	13.00	3.00	6.60	7.50	4.00	5.89
Antique	2.50	1.50	2.04	18.00	12.00	15.75	6.50	6.50	6.50
Bataan	2.50	2.00	2.12	-------	-------	-------	-------	-------	-------
Batangas	3.25	2.00	2.75	17.00	17.00	17.00	3.90	3.90	3.90
Benguet	5.00	3.00	4.10	-------	-------	-------	-------	-------	-------
Bohol	3.75	2.00	2.96	15.00	2.50	10.36	8.50	6.25	7.24
Bulacan	2.50	1.80	2.09	-------	-------	-------	-------	-------	-------
Cagayan	4.25	3.50	4.00	-------	-------	-------	-------	-------	-------
Capiz	4.00	1.80	2.57	18.00	5.00	12.28	7.10	5.00	6.06
Cavite	2.60	2.00	2.26	15.00	15.00	15.00	5.00	5.00	5.00
Cebu	4.50	1.90	3.04	20.00	10.00	13.01	10.00	3.00	7.84
Ilocos Norte	5.50	4.00	5.00	-------	-------	-------	-------	-------	-------
Ilocos Sur	5.00	2.75	4.34	-------	-------	-------	-------	-------	-------
Iloilo	4.00	3.50	2.78	20.00	16.00	17.33	7.50	6.50	6.28
La Laguna	3.50	2.40	2.81	15.00	7.00	10.50	7.00	5.50	5.88
La Union	5.00	3.00	3.68	-------	-------	-------	8.00	6.25	6.56
Lepanto-Bontoc	4.00	3.00	3.55	-------	-------	-------	-------	-------	-------
Leyte	3.50	2.50	3.11	14.00	5.00	9.77	10.00	3.00	6.39
Mindoro	3.00	3.00	3.00	11.00	11.00	11.00	5.00	5.00	5.00
Misamis	3.00	2.00	2.66	11.00	6.00	8.64	7.80	7.00	7.28
Moro Province	2.50	2.00	2.35	15.00	6.60	10.70	7.00	6.50	6.87
Nueva Ecija	3.55	1.25	1.62	-------	-------	-------	-------	-------	-------
Nueva Vizcaya	3.12	1.00	1.87	-------	-------	-------	-------	-------	-------
Occidental Negros	3.00	2.50	2.52	15.00	11.00	13.11	8.50	3.00	6.13
Oriental Negros	4.00	2.50	3.27	14.00	6.50	9.20	8.50	6.00	7.42
Palawan	3.00	2.75	2.87	-------	-------	-------	5.50	5.50	5.50
Pampanga	2.20	1.80	2.05	-------	-------	-------	-------	-------	-------
Pangasinan	4.50	2.00	3.10	-------	-------	-------	7.50	2.50	5.75
Rizal	2.75	2.50	2.54	18.00	18.00	18.00	-------	-------	-------
Samar	4.50	2.50	3.40	14.50	9.00	11.39	7.50	5.00	6.12
Sorsogon	5.00	2.00	3.22	16.00	5.75	10.29	6.50	3.50	5.32
Surigao	3.00	2.50	2.75	12.50	10.50	11.50	7.50	7.00	7.12
Tarlac	3.75	1.40	2.45	-------	-------	-------	-------	-------	-------
Tayabas	5.00	2.00	4.70	15.00	4.00	9.67	6.50	4.25	5.38
Zambales	4.50	1.50	1.80	-------	-------	-------	10.00	2.50	5.25

Highest, lowest, and average of rice, abaca, copra, sugar, tobacco, and corn for the month of January, 1909—Continued.

Province.	Sugar, per picul.			Tobacco, per quintal.			Corn, per cavan.		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Agusan							₱2.50	₱2.00	₱2.25
Albay	₱7.00	₱6.00	₱6.33				5.00	1.50	3.13
Ambos Camarines	6.00	4.00	4.50				4.00	1.50	2.66
Antique	3.25	2.50	2.91						
Bataan	5.00	4.00	4.50				3.00	1.50	2.25
Batangas	4.00	3.00	3.28	₱8.00	₱8.00	₱8.00	3.50	2.00	2.69
Benguet	6.00	4.00	5.00						
Bohol	5.00	4.00	4.25	2.50	2.50	2.50	4.00	2.00	3.08
Bulacan	6.00	6.00	6.00	10.00	10.00	10.00	3.00	3.00	3.00
Cagayan	4.00	3.00	3.66	15.00	8.00	11.60	4.00	2.50	2.90
Capiz	6.00	3.00	5.40	10.00	8.00	9.33	2.00	2.00	2.00
Cavite							3.00	1.50	2.25
Cebu	5.20	2.00	4.19	25.00	4.50	14.19	5.00	2.25	2.57
Ilocos Norte	4.00	2.00	3.00	19.00	4.00	11.50	3.00	2.50	2.83
Ilocos Sur	7.00	2.80	3.43	35.00	16.00	32.75	5.00	1.25	3.03
Iloilo	6.00	4.75	4.57	40.00	7.00	15.02	3.00	2.80	2.90
La Laguna	4.00	3.00	3.75				3.00	2.50	2.66
La Union	5.00	3.00	3.80	9.00	2.00	6.00	1.00	1.00	1.00
Lepanto-Bontoc	7.00	2.50	4.16	13.00	4.00	8.33	5.00	3.00	4.06
Leyte	6.00	3.00	4.40	30.00	2.00	22.60	3.50	1.50	2.70
Mindoro							2.50	2.50	2.50
Misamis	4.00	4.00	4.00	25.00	20.00	22.00	3.00	1.50	2.45
Moro Province	5.25	5.25	5.25				2.50	2.50	2.50
Nueva Ecija	7.50	2.50	5.85	20.00	8.00	11.57	1.50	1.50	1.50
Nueva Vizcaya				20.00	5.00	18.00	2.00	1.50	1.70
Occidental Negros	5.50	3.00	4.21	35.00	30.00	32.50	3.00	2.00	2.33
Oriental Negros	4.00	4.00	4.00	30.00	4.00	12.25	6.00	2.20	3.74
Palawan				20.00	20.00	20.00			
Pampanga	6.00	4.00	4.90				2.60	2.00	2.31
Pangasinan	6.50	3.00	4.18	10.00	5.00	8.47	5.00	1.50	2.55
Rizal	5.00	3.50	3.83	3.75	3.75	3.75	2.50	1.50	2.00
Samar	6.00	5.00	5.50	6.00	6.00	6.00	2.50	2.50	2.50
Sorsogon	3.50	2.50	2.85				3.25	2.00	2.32
Surigao	4.00	4.00	4.00	15.00	9.00	12.00	1.50	1.50	1.50
Tarlac	4.00	2.00	3.40	12.00	8.00	10.00	2.20	2.00	2.10
Tayabas	3.00	3.00	3.00	8.00	6.00	6.66	5.00	5.00	5.00
Zambales	5.00	3.00	4.88	25.00	12.00	18.50	5.00	2.00	3.50

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THE PHILIPPINE

Agricultural Review

VOL. II MAY, 1909 No. 5

CONTENTS AND ILLUSTRATIONS.

CONTENTS.

ILLUSTRATIONS.

EDITORIAL.

LAWS TO PREVENT THE INTRODUCTION OF PLANT PESTS.

The attention of the readers of this number of the REVIEW is invited to the ordinance to prevent the introduction of plant pests into the Straits Settlements and the extract from the report of the government entomologist of Hawaii for November and December. The fact that the importance of this matter has been recognized by the government of the

Straits Settlements and the government of Hawaii by appropriate legislation is significant. The extract from the report of the government entomologist in Hawaii for November and December is in itself *prima facie* evidence of the need of laws to prevent the introduction of plant pests and diseases in all countries wholly or nearly surrounded by the sea, where a large part of the vegetables consumed by the people are imported from other countries, and where, as is the case in the Hawaiian Islands, the Philippines, and the Straits Settlements, a great many new plants are being imported from foreign countries for the purpose of promoting agriculture.

Our Government has given considerable attention to enacting laws to prevent the importation of animals infected with contagious diseases and to provide for the isolation and quarantine of animals infected with such diseases in the different parts of the Islands. It is believed that some satisfactory law providing for the inspection of the plants and vegetables which are imported into these Islands and for guarding against the introduction of plant pests and diseases which are common in other countries would be beneficial to our public health and progress.

AGRICULTURAL EXHIBITIONS.

In this number of the REVIEW we are giving an account of the agricultural exhibitions at Medan, Sumatra, the annual agri-horticultural show of Perak, and the balance sheet of the agri-horticultural show of Selangor.

The account of the agricultural exhibition held at Medan, Province of Deli, Sumatra, it is believed, will be particularly interesting to the tobacco growers of the Philippines, as Sumatra is known the world over for its superior grades of tobacco, particularly its leaf tobacco which is used for wrappers by nearly all of the leading cigar factories in the world. At the Medan exhibition nursery beds with vigorous living specimens of the different kinds of tobacco plants grown in Sumatra were shown, giving planters the advantage of seeing other kinds of tobaccos than those usually cultivated on their own estates. Samples of the different kinds of tobacco soils from the leading tobacco estates in Deli, Langkat, Serdang, etc., as well as a complete equipment of apparatus for the analysis of soils, were on exhibit. In addition to this a complete series of plants affected by diseases common to the tobacco plant were exhibited under glass cases, showing the different stages of the diseases, and the insects which in many cases produce them, so that each disease could be easily studied. Further than this many phases of tobacco culture were illustrated by large photographs.

In connection with the account of the exhibition at Medan we have reproduced a brief sketch of the country and the conditions that prevail on the tobacco estates in Deli and Sumatra, which will give Philippine

tobacco growers a very fair idea of the environment and conditions under which the tobacco-growing industry is carried on in Netherlands India.

The agri-horticultural show which was held at Kuala Kangsar in Perak, is an annual affair in the State of Perak. At the fairs held in the Federated Malay States the leading exhibits are of the rubber-growing industry. It is claimed that these fairs are a great stimulus and source of information and progress to the planters of the States; that they spread a desire amongst the natives to improve their different cultivations and give a great deal of help to those engaged in tropical agriculture, by indicating the direction in which the greatest assistance is needed, and the manner in which it can best be given. These shows are not only a financial success, as is shown by the credit balance of $712.28 for the fair at Kuala Kangsar, but they increase in excellence from year to year, the quality of the exhibits being much in advance of those of former years.

From the balance sheet of the agri-horticultural show held at Kuala Lumpor in Selangor, we can see something of the plan of the exposition and its business management, showing the methods of promoting expositions by prizes, medals, and money awards, as well as by advertising, which, when all the receipts are totaled and the expenses paid, give a cash balance of $2,327.40 in the bank. This account of these fairs and exhibitions in the Federated Malay States and Netherlands India show how far in advance of us these countries are in agricultural development and progress. Such exhibitions from the various parts of a province, state, or island stimulate local pride in their agricultural products and progress, and these in turn create a desire for better knowledge of agriculture as well as better business, and better means of communication; which, perhaps, are the greatest needs for elevating the standard of living in the country in these Islands and for encouraging the organization of the people of the country into guilds, unions, or granges for promoting the different lines of agricultural work in which they are interested.

It is hoped that the bill recently introduced into the Assembly providing for the holding of provincial industrial and agricultural exhibitions in these Islands, or a bill that will meet the present needs of the country, will become a law, and that it will meet with a hearty response and its provisions be immediately taken advantage of by the people of the provinces.

AGRICULTURE IN THE FEDERATED MALAY STATES.

Perhaps one of the most interesting articles in this number of the REVIEW, to a great many of our readers, will be the discussion of the progress of agriculture in the Federated Malay States by the director of agriculture for the Federated Malay States.

While the bureau of agriculture in the Federated Malay States has been organized for only three years there are several phases of its work which are of interest to agriculturalists in the Philippines. We refer more especially to the division of mycology and the work of the government mycologist in Singapore, also to the carefully made experiments in rice or *padi* culture, and to the attention which is given to the coconut industry by the appointment of an inspector and assistant inspector of coconuts.

The table giving the acreage of the different crops which are grown in the Federated Malay States shows the rubber-growing industry decidedly in the lead of all other agricultural work and that the acerages of coconuts and coffee plants follow in the order named.

The account of rice growing in the Federated Malay States, together with the detailed statement regarding the experiments which were carried on with different varieties of rice, should be interesting to Philippine rice growers. In the Federated Malay States about 70,000 acres of rice land have been supplied with comprehensive irrigation works, which thus far have given an increase of from 30 to 40 per cent in the crop harvested. Under the discussion of the enemies of the rice plant, Philippine farmers will see that the farmers of the Federated Malay States have to combat very much the same pests and insect enemies, such as rats, eelworms, and fungi, that we have to contend with here in the Philippines. The table tabulating the results of the experiments carried on with the different varieties of rice planted shows the time of planting seed, the dates transplantings were made, how many plants were set together in a hill or "perdu," the distance between settings or "perdus," the number of plants and "perdus" per acre, the date of harvesting the crop, the amount of the crop in gantongs or gallons and pounds per acre, the weight of straw per acre, also the number of grains in one gram and the number of seeds per head for each variety.

However, the larger part of this discussion and by far the most interesting and remarkable feature of it is that showing the growth and development of the rubber-growing industry in the Federated Malay States during the last ten years. This is well illustrated in the accompanying map and chart which is reproduced with the article. The increase in the acreage and the number of trees planted in the Federated Malay States during the last ten years is perhaps without parallel in the development of any other agricultural product in any part of the world. Not only has the development of rubber planting and rubber growing in the Federated Malay States been decidedly remarkable, but the possibilities for the future development and production of plantation rubber from the estates already planted and under cultivation quite equal, if they do not surpass, the progress made by our neighbors in rubber growing during the past ten years. The achievement is so great that we are disposed to ask our agriculturalists in the Philippines, Are

not such achievements possible in these Islands? and, What would be the result of such an achievement on the agricultural and commercial status of this country?

COUNTRY LIFE COMMISSION.

Our purpose in presenting these articles from the pens of President Roosevelt and the Editor of the Outlook is not for their intrinsic value to citizens of the United States, but for their suggestiveness to those of us who are responsible for, and must solve, the problem of country life in the Philippines. Life in the country in these Islands is the foundation of all of the national aspirations and of the future greatness of the Filipino people. It is the country life in the Philippines more than anything else that needs to be awakened and quickened.

The politician is in the very center of the stage of the popular life of the people at the present time. The Filipino Government official is everything. The country seems to be dormant, and the people in the country depend upon the officeholders and politicians for all remedies of present evils and for the improvement of conditions. In the mind of the average country resident the situation is entirely in the hands of the lawmakers, and they, the people in the country, are doing little or nothing, resting in the conviction that everything that is necessary to bring about the much-needed changes for the progress of the country, can be accomplished by their officials and lawmakers. Nothing could be further from the truth. There is no such thing as independent national or state government without resources; and laws are primarily for the regulation of the conduct of the people. Laws can not make the people industrious nor can they fundamentally create resources. Abundant resources and wealth are the foundation of national life, as well as of the life of a business corporation. The country, the farmer, and the rural population, are the resources and the fundamental producers of wealth—the foundation of national existence—and through them only can national existence be made possible.

The recent protest of the sugar planters is much like a protest against the building of a house without a foundation. This is the first voice which has been heard from the land, from the country people. They are the very people that need to be encouraged to speak for themselves, and life in the country needs to be stimulated and given every possible support and encouragement. In fact, it should be made the center of attention both of the people and the Government. The eyes of the public should be turned to the farmers and the country people, and they should be placed in the center of the stage of action. For a time, at least, the politician can well be forgotten and left to work out his problems, not so much in the public forum, but rather in conference with the people who are the real producers of wealth.

For the past eight years we have been facing the condition of importing annually an average of ₱13,758,890 worth of rice; ₱154,570 worth of coffee; ₱368,114 worth of cacao and chocolate; ₱237,248 worth of sugar; ₱552,108 worth of eggs; ₱14,216,238 worth of cotton goods. The United States might as reasonably import her wheat, milk, butter, meat, and potatoes. *Such a national foundation is as frail as straw and as unstable as water; such a condition is a condition of dependence and not independence.* A country in which the people will not produce the food staples necessary for their own subsistence and right living, when the land naturally produces such products, can be nothing more than a dependency no matter how brilliant its statesmen and professional men.

The editor knows of no better expression or statement of the needs of the people and the government of this country—in order that the Filipinos may attain to the ends most desired by them—than the following by a prominent Filipino:

> We should earn sufficient money to live in such a manner as to produce healthy and vigorous children, and educate them so that their earning capacity will be still greater. In which case, I swear upon my honor that our grandchildren with their health, education, and money will be independent in spite of everything. * * * America freed herself from England because she had men, money, and true patriots.

In his message President Roosevelt points out the various agencies for the improvement of country life, namely:

(1) The National Department of Agriculture,
(2) The State departments of agriculture,
(3) The State colleges of agriculture,
(4) University and agricultural extension work.
(5) Agricultural experiment stations,
(6) Farmers' unions,
(7) The Grange, and
(8) The agricultural press.

In the Philippines we have but few of these agencies in either the Insular, provincial, and municipal government organizations or among the people. Act No. 1829 provides for civico-educational instruction, yet the need of agents or officials charged with the responsibility for improving the existing conditions of country life is manifest and decidedly emphatic to anyone who fairly considers the situation.

The President emphasizes the importance of organization on the part of the farmers themselves, and states that the country people must organize to protect their interests as well as any other class of industrial workers. The Government can point out the way, but as indicated, the country people must coöperate and must give dignity and attractiveness, as well as better results from the farms, if country life is made all that it can and should be. In the Philippines we not only

need better farming, which the Bureau of Agriculture is endeavoring to stimulate and encourage, but we most emphatically need *better business* and *better living on the farms.* President Roosevelt states that the farmers' problems are the whole country's problems. The President further asserts that neglect of this subject has held back country life and lowered the efficiency of the whole nation. Perhaps no other subjects received so little attention during the period in which the Philippine Islands were governed by the Spaniards as the education and elevation of the people in the country, and work for the improvement and development of those things which were for the best interests of the country people. The President declares that the strengthening of country life is the strengthening of the nation; that while the growing of crops is an essential foundation, it is only a part of the life of the people in an intelligent and progressive country; that it is literally vital that the farmer, his wife, and his children shall lead the right kind of life. He believes that the National Department of Agriculture should become a department of country life, fitted to deal not only with crops, but with questions pertaining to all of the larger aspects of life in the open country.

President Roosevelt points out three great needs of country life, namely:

I. *Effective coöperation among farmers to put them on a level with the organized interests with which they do business.*

II. *A new kind of schools in the country which shall teach the children as much outdoors as indoors and perhaps more, so that they will prepare for country life and not, as at present, mainly for life in town.*

III. *Better means of communication, including good roads and a parcels post.*

In addition to these he suggests a fourth, viz:

Better sanitation. Inasmuch as many easily preventable diseases hold millions of country people in the slavery of continuous ill health.

In conclusion, President Roosevelt warns our countrymen that the great recent progress in city life is not a full measure of our civilization, for our civilization rests at bottom on the wholesomeness, the attractiveness, and the completeness, as well as the prosperity of life in the country. The men and women on the farm stand for what is fundamentally best and most needed in our American life.

PHORMIUM TENAX, A COMPETITOR OF SISAL AND MANILA HEMP.[1]

Phormium tenax has at least one advantage over its rivals in that its yield per acre is considerably higher than the yield per acre of abaca and sisal.

Taking sisal, to begin with, in Yucatan the weight averages about 50 pounds to forty leaves, 4 per cent of which becomes profitable fiber, or 2 pounds of fiber per plant of forty leaves. Allowing 1,000 plants to an acre, the yield of fiber is about 17 to 18 hundredweight per acre. The green leaf is usually harvested when it is three or four years old, but it has been placed on record—so that fact must be a notable one—that a two years' old plantation produced 1½ tons of fiber per acre. In Hawaii, whose porous, coral soil is admirably suited to its growth, as much as 3 tons 15 hundredweight to the acre has been yielded, but this agave was in a highly cultivated state.

Manila or abaca has even a smaller percentage of fiber per acre. Under favorable conditions anything from 6 to 9 hundredweight per acre is produced, although the average yield throughout the Islands is considerably below that figure, being a little over 3 hundredweight per acre. The life of the plant or root lasts from twelve to fifteen years, and from ⅓ pounds to 1 pound of fiber is obtained from a single stalk. In southern Mindanao the yield is something like 48 tons of stalks to a ton of fiber. The average amount of fiber produced is about 1½ per cent.[2]

Coming to our own hemp the green leaf per acre in this district is anything from 20 to 32 tons, though it is sometimes considerably above the latter figure. Allowing 8 tons of green leaf to one of fiber, and taking the above figures, the yield would be 2½ to 4 tons per acre. Allowing 7½ tons of leaf to a ton of fiber, the yield would be 2⅔ to 4¼ tons of fiber per acre.

Of course the writer is taking these figures, dealing with the yield of our own hemp, only for the purpose of striking an average. The quantity of green leaf per acre often varies considerably in the same block. About 12½ per cent of green leaf becomes fiber, although some millers get over 13 per cent.

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[1] From the Auckland Weekly News, February 18, 1909.

[2] While these figures are correct for the hand-stripping process this amount can and doubtless will be increased two or three times by the use of satisfactory machinery.—EDITOR.

Maguey or henequen, which is another variety of sisal, yields from 5 to a little over 7 hundredweight of fiber per acre. The Philippine exports of this fiber increased from 875 tons in 1901 to 2,328 tons for the first nine months of 1906.

The hemp graded during the month of January was 6,323 bales, as compared with 12,086 bales for January, 1907, a decrease of nearly 50 per cent. For the year ending January 31, 1909, 83,606 bales were graded, a decrease for the year of 55,414 bales.

There is an interesting article in the London Field dealing with New Zealand flax, in which the writer states that 15 per cent of the green leaves are pure fiber, and the plant is as tenacious of life as a dock, provided the conditions of soil and climate are suitable. The great obstacle to the plant becoming of first importance among the world's vegetable fibers is the difficulty experienced of arriving at a process that will extract the fiber at a reasonable cost. "The prospect of labor in New Zealand being more costly than in other countries, where *Phormium tenax* can be cultivated, is likely to widen the field of this particular industry." The writer mentions the following localities where it is grown, and where it would thrive: Devon, Cornwall, Scilly Islands, and parts of Ireland.

Attempts are being made to introduce the *Phormium* industry into the United States, and in St. Helena there have been plantations of it for years, where it is being systematically cultivated. The author of the article concludes by referring to its white, silky texture, with a higher breaking strain than either hemp or flax. He states the fiber would be assured of a market, provided the natural quality was retained, if the supply were increased a hundred fold of what it is at present.

THE PRODUCTION AND CONSUMPTION OF CACAO.[1]

The "Gordian" has recently published (July 23, 1908) some interesting statistics regarding the production and consumption of cacao during the past few years. It appears that while the production for 1907 may be considered satisfactory upon the whole, it is 400,000 kilograms less than that of 1908 and 3,000,000 kilograms less than that of 1904. This deficit is due solely to a shortgage in the production in Ecuador and the Dominican Republic, the output for these countries being 8,000,000 kilograms less in 1907 than in 1906.

The table which we reproduce below gives in kilograms the exportation of cacao from the principal cacao-producing countries, for the years 1906 and 1907:

PRODUCTION.

Country.	1906 (kilograms[a]).	1907 (kilograms).
Brazil	25,135,000	24,528,000
St. Thomas	24,619,560	24,193,980
Ecuador	23,426,897	19,670,571
Trinidad	12,983,467	18,611,430
Venezuela	12,864,609	13,471,090
English East Africa	9,738,964	10,471,090
Dominican Republic	14,312,992	10,101,374
Ceylon	2,509,622	4,699,559
New Granada (Colombia)	4,931,530	4,612,100
Fernando Po	1,557,864	2,438,821
Jamaica	2,505,608	2,218,741
German colonies	1,367,977	1,966,236
Haiti	2,107,905	1,850,000
Dutch East Indies	1,849,847	1,800,153
Cuba	3,271,969	1,689,668
Surinam	1,480,568	1,625,274
French colonies	1,262,090	1,387,219
St. Lucia	716,200	750,000
Dominica	572,948	580,000
Congo Free State	402,429	548,526
Other countries	1,000,000	1,000,000
Total	148,618,046	148,136,537

[a] One kilogram equals 2.20462 avoirdupois pounds.

Regarding the exportations from Ecuador we may add that the official reports have confirmed, with a difference of several thousand kilograms, the figures of the "Gordian" (19,703,804 kilograms instead of 19,670,571 kilograms). The estimated crop for 1908 in this country amounts to over 30,000,000 kilograms.

[1] From the "Journal d'Agriculture Tropicale," December, 1908.

The production of 1,387,219 kilograms attributed to the French colonies is distributed as follows:

	Kilograms.
Guadalupe	781,511
Martinique	502,789
Congo	74,733
Madagascar	19,041
Guiana	3,807
New Caledonia	2,352
Ivory Coast	1,993
Réunion, Mayotte, and Indo-China	953

Among the German colonies Cameroon leads with 1,797,614 kilograms, Samoa follows with 116,500 kilograms, and Togo with 52,122 kilograms showing an enormous increase over the preceding year.

The record for the English colonies of West Africa is as follows: Gold Coast 9,504,000 kilograms, and Lagos 970,745 kilograms.

CONSUMPTION.

In consumption of cacao for the year 1907 the United States leads with 37,526,505 kilograms; then comes Germany with 34,515,400 kilograms; France with 23,180,300 kilograms; England 20,159,472, Holland 12,219,249, Switzerland 7,124,200, Spain 5,628,239, Austria 3,471,700, Belgium 3,253,967, Russia, Italy, Canada, Denmark, etc., with a total of 7,619,809 kilograms.

THE AGRICULTURAL EXHIBITION AT MEDAN, SUMATRA, AUGUST 31, 1908.[1]

The exhibition was held on the esplanade facing the station, the area of which is said to be about 7 acres in extent, and so numerous were the buildings that every part of it was covered. The arrangements were in the hands of a general purposes committee with the resident of the east coast as president and each of the eight divisions was managed by sub-committees. The divisions were as follows: (*a*) Buildings, (*b*) industrial arts, (*c*) chinese, (*d*) agriculture, (*e*) cattle, (*f*) Battak, (*g*) Amusement, and (*h*) fisheries. Judging from the admirable way every thing seemed to work, the organization was excellent. The buildings were solid structures of planking, with *atap* roofs, and I was informed that the large structure known as the feast tent, put up a little while ago by the railway company when celebrating their twenty-fifth anniversary, cost 8,000 guilders.

The building allotted to the agricultural section was a lofty-domed octagonal structure with avenues radiating from it. The central portion contained the very complete collections of tobacco leaves of nearly every known kind of tobacco; whilst outside the building on one side was a series of nursery beds showing the tobacco plants in vigorous growth. This was a wise precaution, for at this season the tobacco grown on the estates is all harvested, so that it gave visitors an opportunity of seeing the living plants and planters of seeing other kinds of tobacco than those usually cultivated on their estates.

In addition to the different kinds of tobacco shown in the central hall, the director of the agricultural experimental station showed a complete series of plants under glass cases which were more or less affected by diseases which prey on tobacco, together with the distinctive insects in their various stages, all neatly set up in glass cases, easy to inspect and study. To supplement the above, there were a number of huge photographs on the walls all of which illustrated some phase of tobacco culture. Not less interesting were the samples of soils from different parts of Sumatra, Deli, Langkat, Serdang, and other places, also a complete equipment of apparatus for the analysis of soils was shown alongside. The remaining exhibits in the central building call for no

[1] **Extracts from the report of Mr. W. Fox, in Agricultural Bulletin of the Straits Settlements and Federated Malay States, Vol. VII, No. 11, November, 1908.**

comment, being of such things as harness and saddlery, a few cases of tools, etc.

No. 1 avenue was devoted to agricultural implements used on estates, such as plows, various baskets and hand barrows for carrying tobacco leaves; levels, and road tracers and such like. Avenue No. 2 contained some most interesting agricultural produce. The lower half was occupied by the United Serdang Sumatra Rubber Plantation Company, who showed some excellent Liberian coffee in bulk, both in cherry and parchment, some bales of the tree cotton cleaned and uncleaned. The most interesting of their exhibits was the Rambong rubber. Arrangements had been made for a supply of latex and the processes of coagulating and washing were gone through. A 12-horsepower Campbell oil engine, and a Brown & Davidson washer were used for these purposes. Mr. V. Ris, the general manager, also gave an exhibition of tapping the Rambong, which contrary to the usual practice was in the herringbone style. I was informed that on one of their estates they had 30,000 trees each yielding about 1½ pounds of dry rubber, which sold at about 2 shillings 6 pence per pound, as against about 4 shillings 2 pence for fine Para. I noticed three Para rubber trees about 2 or 3 years old which had been pulled up by the roots; they were badly attacked by the Para rubber fungus, *Fomes semitostus*, and in conversation with Mr. Ris he stated that when a tree was discovered infected with it the trees should be destroyed for one-fourth of an acre round to stamp it out. The remaining portion of this avenue was for the most part occupied by Mr. L. A. Range, general manager of several estates, who showed Rambong in sheet form. Seeds of Para, Lagos, silk, and Rambong rubbers, ratans, *padi* in the ear, sugar from the sugar palm, gambier, tea, vanilla, wood specimens, and a brick-making machine completed this avenue. None of the last named were in any quantity, nor do they call for any special comment, except, perhaps in case of the vanilla pods, which were very good and show what can be done with this plant which is somewhat difficult to cultivate. The remaining avenues were taken up by exhibits of tradesmen, who showed almost every thing a planter could want in the way of tools and machinery for the estate. The models of estate buildings, such as drying and fermenting sheds, coolie lines, etc., were on a large and comprehensive scale. As regards the rest of the exhibition it consisted of an unrivaled collection of articles from the Battaks. The pottery, brass work, and gold thread cloth from Java, were also of an excellent description. The brush and basket work of the blind from the Bandoeng Institute, Java, was strong and serviceable.

I was informed that the entire exhibition cost between $50,000 and $60,000 of which the management hoped to get back about 50 per cent by gate money, etc., and judging by the crowds of natives that swarmed through the grounds, I think they did it. Ten thousand natives went through the barriers on Monday the 31st.

DELI.[1]

It is believed that the following sketch of the Province of Deli will interest our agriculturalists, more especially the tobacco growers of the islands.

Belawan.—On approaching Belawan, the harbor of Deli, the shore of Sumatra displays the same character as in the Banka Strait; a long, low, dark-green streak with a straight, unbroken line of coast stretching out into the muddy sea, while its upper edge, smooth and uniform, borders on the moist atmosphere, quivering with heat. It is only in the morning that we see, far inland, a ridge of dim blue mountains, from which rise a couple of finely delineated volcanic cones. One of these is distinguished by a greyish-yellow tint, which has gained for it, erroneously, the name of *Sulphur Mountain* and sometimes by a white plume of smoke hovering over its summit.

A broad stretch of lowland between the mountain range and the coast has been formed by the sinking of the mud washed away from the mountains at the mouths of the rivers and on both sides of their banks by the periodical inundations. The land is being continually increased by the woods along the coast, growing half into the sea, which consist almost entirely of mangrove or rhizophoræ trees (*bakoe*) standing above the water on a labyrinth of air roots, between which the mud remains hanging and accumulates. Thus the bottom of the sea, on which they take root, gradually becomes dry land, but underneath, along their outer edge a new fringe of young plants has come up which continue to form land.

Slowly and cautiously, the steamer creeps in over the mud-bank at the mouth of the river; often compelled to stop or run aground on the soft and continuously shifting bottom which the screw keeps sending up in dirty brown flakes. To the right and left, we see far out at sea, the nets of the Malay coast fishers.

Once over the bar, the boat can soon cast anchor in the spacious mouth of the Kwala Belawan, right opposite the station of the Deli Railway. Along the gangway we reach the pier, pass without much difficulty or loss of time, the custom-house, and with one of the many trains soon leave the damp, warm, and always very unhealthy harbor, and in a couple of hours reach the town of Medan.

Before arriving at Medan, we have already gained an impression of the characteristic scenery of Deli: a large, bare, monotonous surface, for the most part covered with high alang-alang grass—here called lalang[2]—or with wild, tangled shrubs; little inhabited, except where here and there a tobacco plantation lies in the midst of the fields. If we come at the time when the tobacco has been gathered in, then we see the greater part of these fields planted with rice, which the native population, according to their farm lease, may grow during the first year upon the fallow-lying tobacco fields. A few campongs with their fruit trees, and here and there a solitary *toealang* (bee-tree), which was spared when the primeval forest was rooted up, fail to break the monotony and desolateness of the scenery. On the contrary, they rather tend to increase it.

Near Medan we pass over an extensive railway embankment full of luggage trains and sheds, that gives one a lively impression of the commerce and prosperity which prevail in this tobacco country. The numerous crowds of native, or rather non-European travelers at every station, produce the same impression: Chinese, Malays, Javanese, Klingalese, Bengalese, and Battaks swarm on the quays and fill the numerous and spacious third-class carriages. The majority of these people

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[1] From Van Bemmelen and Hooyer's "Netherlands India."

[2] Alang-alang, lalang, *Imperata arundinacea* is the common cogon grass of the Philippines.

come from other parts, for the original Malay population was, and is still, small. When the first tobacco planters came to Deli, the country was as thinly populated as the districts lying south and north of it on Sumatra's east coast.

So the planters were compelled to look for workmen elsewhere. The nearest place where coolies could be obtained was the Straits Settlements, which supplied Chinamen, who appear admirably adapted for the cultivation of tobacco. As, however, the prices of the English coolie brokers were exorbitantly high, the Deli Company contrived to effect a direct immigration from China. In smaller numbers there come to Deli, Javanese, Bewanese, Bandjarese, Klings (of the coast of Malabar), and Bengalese, the men of the last two races not, however, direct, but only from the Straits, and then, too, against the wishes of the English Indian Government.

All of the buildings and appurtenances of the railway look new and modern, which can easily be understood when we remember that the line was only laid down in 1886.

At Medan the line is divided into three branches: One to the left (on the east) runs to Serdang (Perbaoengan); the middle one, a continuation of the main line to Deli Toewa, on the slopes of the foot ridges of the mountain range; and the one to the right runs (in a northern direction) to Bindjei and Seleseh.

At Bindjei begins a narrow-gauge railway to Stabat on the Wampoe, in the direction of Tandjong-Poera (Klambir), constructed and worked by the Deli Company. When the tobacco is shipped, we see many wagons laden with neat bales of tobacco, packed in fine matting, but at all times the railroad yards are full of loads of imported articles, especially atap[1] (covering for roofs), and sticks for drying the tobacco (*anaq kajoe*), wood, uncut and cut, stones, chalk, ironwork, artificial manure, provisions, liquors, rice, and fish.

Medan, the chief place of Deli, electrically lighted, is the seat of the resident of the east coast of Sumatra, and of the Sultan. It lies on the Deli River at its confluence with the Boboera. As soon as we have stepped out of the station into the spacious aloen-aloen, we perceive at the first glance that we have arrived at a new, busy, and flourishing place. In 1869 it was chosen by Nienhuys, the originator of the Deli Company, as the seat of their chief administration on account of its adaptability for import and export. Before that time it was a wretched campong surrounded by a double wall, traces of which still remain.

What especially strikes the European coming from Java is the more modern Western character in the laying out of the grounds and buildings, the greater variety in architecture, adapted to the mixed population. The cause of this lies in the proximity of the Straits Settlements and the overwhelming influence of the planters, who form the chief element of the European colonists. These, of all nations, chiefly consisting of young enterprising men fresh from Europe, have imprinted a Western character upon everything, and in the arrangement of their dwellings and plantations have followed the examples of their English neighbors across the Straits, rather than those of Java, which lies farther off. In society we shall observe a closer connection with Europe, as the Deli tobacco planters travel more frequently to and from Europe than the Dutch settlers of Java, who still, to a great extent, keep up the old custom of remaining ten and even twenty years in the tropics.

The Deli Company.—This company has its chief office here. This, the largest and oldest of the many tobacco-cultivating companies, was established in 1869, and not long ago, celebrated its twenty-fifth year of existence. They then had 100,000 acres of land at their disposal, divided into twenty-one plantations in

[1] Atap, *Nipa fructicans* is the common nipa palm of the Philippines.

the Provinces of Deli and Langkat, and worked with a capital of 4,000,000 guilders and a reserve capital of four and a half millions. By their instrumentally, direct immigration of coolies from China was brought about; and by one of the members of their administration, a plan was devised by which the relations between the coolies and their masters were placed on a good and satisfactory basis.

That the Deli Company provides well for their workmen, is shown by their hospital and also their asylum for immigrants, which they built in connection with other planters. Here contract coolies, who by chronic or incurable diseases are unfit for work, find a temporary or permanent home.

Tobacco plantation.—Everywhere one will find the arrangements much the same:—In the middle a spacious house for the director, erected after the English-Indian bungalow type, rises high out of the ground. Next to it extends a gigantic fomenting barn to which the tobacco is taken in the month of July to lie and foment for from six to nine months upon piles which keep getting larger and higher, whilst beginning in September they are sorted by coolies who are seated in two long rows at the open sides; at the outside are the sorters and opposite them those that make up the bundles.

Then the large airy shed of the Chinese workmen, the so-called "kongsi," in the neighborhood of which one or more native shops, here named "kedei," are to be found, and other dwellings of Javanese, Klingalese or Boyans. Each of these races has its own peculiar labor; the Javanese are woodmen, roadmakers and gardeners; the Klingalese, cowherders and drivers of ox wagons (*kareta lemboe*); the Bengalese, policemen, and the Boyans, carpenters; whilst the clearing of the forest is done by Battaks and Malays, temporarily engaged, who can also build barns and make roads.

The tobacco fields are divided into from four to six groups over the extensive land of the plantation, of which every year only a tenth to a fifth part is used for tobacco growing. Each of these groups is under the superintendence of an assistant, who has under him about 100 workmen. On both sides of a plantation road are found the fields, which in January, February, and March are prepared for the reception of the young plants by the cutting down and burning of the trees and by working the soil with the "tjankol," or native spade. In April the "bibit," which has been sown on forcing beds, is planted out on it, which in July can develop into plants (tobacco trees) as high as a man. These are then cut down and taken to the drying sheds. The lofty, long sheds, with their gigantic roofs of 'atap,' are arranged in a long row by the high road, and are a characteristic of Deli scenery.

The fallow-lying fields may for a year be sown with rice by the population. After this time, they are left to themselves and are soon covered with a wilderness of bushes or else high alang-alang grass. The latter is getting too much the upper hand in Deli, principally owing to the burning down of the forests, which, either by accident or on purpose, are set on fire and can not grow again. The rewooding of land from which the tobacco has been gathered, is, therefore, one of the most difficult and important problems in Deli.

THE COUNTRY LIFE COMMISSION.

Some time ago President Roosevelt appointed Prof. L. H. Bailey, director of the agricultural college and experiment station for Cornell University; Mr. Gifford Pinchot, Chief of the United States Forestry Service, Washington, D. C.; Mr. Walter H. Page, editor of "Country Life in America;" President Kenyon L. Butterfield, of the Massachusetts Agricultural College, and Mr. Henry Wallace, editor of "The Wallace Farmer," in Iowa, as a commission to investigate the conditions of life on the farms of the country and to make recommendations as to the best ways and means by which farm life can be made more remunerative and attractive.

The commissioners held thirty public hearings among the people from forty different States and Territories, and have 120,000 answers to printed questions. The members of the commission have received nothing for their work on the commission and their service is an expression of public spirit which is a credit and, perhaps, one of the best resources any nation could have.

PRESIDENT ROOSEVELT'S MESSAGE.

On February 9 last, President Roosevelt submitted the report of the commission to Congress. The President's message commenting on the work of the commission is as follows:

I transmit herewith the report of the Commission on Country Life. At the outset I desire to point out that not a dollar of the public money has been paid to any commissioner for his work on the commission.

The report shows the general condition of farming life in the open country and points out its larger problems. It indicates ways in which the Government, National and State, may show the people how to solve some of these problems, and it suggests continuance of the work which the commission began.

METHODS OF THE COMMISSION.

Judging by thirty public hearings, to which farmers and farmers' wives from forty States and Territories came, and from 120,000 answers to printed questions sent out by the Department of Agriculture, the commission finds that the general level of country life is high compared with any preceding time or with any other land. If it has in recent years slipped down in some places, it has risen in more places. Its progress has been general, if not uniform.

Yet farming does not yield either the profit or the satisfaction that it ought to yield and may be made to yield. There is discontent in the country and in places discouragement. Farmers as a class do not magnify their calling and the movement to the towns though, I am happy to say, less than formerly is still strong.

HOW FARMERS CAN HELP THEMSELVES.

Under our system it is helpful to promote discussion of ways in which the people can help themselves. There are three main directions in which the farmers can help themselves, namely: I, *Better farming;* II, *better business;* III, *better living on the farm.*

The *National Department of Agriculture,* which has rendered services equaled by no other similar department in any other time or place; the *State departments of agriculture,* the *State colleges of agriculture and the mechanic arts,* especially through their extension work; the *State agricultural experiment stations,* the *Farmers' Union,* the *Grange,* the *agricultural press* and other similar agencies have all combined to place within the reach of the American farmer an amount and quality of agricultural information which if applied would enable him over large areas to double the production of the farm.

The object.—The object of the Commission on Country Life, therefore, is not to help the farmer raise better crops, but to call his attention to the opportunities for *better business* and *better living on the farm.* If country life is to become what it should be and what I believe it ultimately will be—one of the most dignified, desirable and sought after ways of earning a living—the farmer must take advantage not only of the agricultural knowledge which is at his disposal, but of the methods which have raised and continue to raise the standards of living and of intelligence in other callings.

Organization.—Those engaged in all other industrial and commercial callings have found it necessary under modern economic conditions to organize themselves for mutual advantage and for the protection of their own particular interests in relation to other interests.

The farmers of every progressive European country have realized this essential fact and have found in the coöperative system exactly the form of business combination they need.

Now, whatever the State may do toward improving the practice of agriculture, it is not within the sphere of any government to reorganize the farmers' business or reconstruct the social life of farming communities. It is, however, quite within its power to use its influence and the machinery of publicity which it can control for calling public attention to the needs and the facts. For example, it is the obvious duty of the Government to call the attention of farmers to the growing monopolization of water power. The farmers, above all, should have that power, on reasonable terms, for cheap transportation, for lighting their homes, and for innumerable uses in the daily tasks on the farm.

FARMERS' OWN COÖPERATION AND WORK NEEDED.

It would be idle to assert that life on the farm occupies as good a position in dignity, desirability, and business results as the farmers might easily give it if they chose. One of the chief difficulties is the failure of country life as it exists at present to satisfy the higher social and intellectual aspirations of country people. Whether the constant draining away of so much of the best elements in the rural population into the towns is due chiefly to this cause or to the superior business opportunities of city life may be open to question. But no one at all familiar with farm life throughout the United States can fail to recognize the necessity for building up the life of the farm upon its social as well as upon its productive side.

It is true that country life has improved greatly in attractiveness, health, and comfort and that the farmer's earnings are higher than they were. But city life is advancing even more rapidly because of the greater attention which is being

given by the citizens of the towns to their own betterment. For just this reason the introduction of effective agricultural coöperation throughout the United States is of the first importance. Where farmers are organized coöperatively they not only avail themselves much more readily of business opportunities and improved methods, but it is found that the organizations which bring them together in the work of their lives are used also for social and intellectual advancement.

The coöperative plan.—This is the best plan of organization wherever men have the right spirit to carry it out. Under this plan any business undertaking is managed by a committee. Every man has one vote and only one vote, and every one gets profits according to what he sells or buys or supplies. It develops individual responsibility and has a moral as well as a financial value over any other plan.

THE FARMERS' PROBLEMS THE WHOLE COUNTRY'S PROBLEMS.

I desire only to take counsel with the farmers as fellow-citizens. It is not the problem of the farmers alone that I am discussing with them, but a problem which affects every city as well as every farm in the country. It is a problem which the working farmers will have to solve for themselves, but it is a problem which also affects in only less degree all the rest of us, and therefore if we can render any help toward its solution it is not only our duty but our interest to do so.

The foregoing will, I hope, make it clear why I appointed a commission to consider problems of farm life which have hitherto had far too little attention and the neglect of which has not only held back life in the country, but also lowered the efficiency of the whole nation. The welfare of the farmer is of vital consequence to the welfare of the whole community. The strengthening of country life, therefore, is the strengthening of the whole nation.

The commission has tried to help the farmers to see clearly their own problem and to see it as a whole, to distinguish clearly between what the Government can do and what the farmers must do for themselves, and it wishes to bring not only the farmers, but the nation as a whole, to realize that the growing of crops, though an essential part, is only a part of country life. Crop growing is the essential foundation, but it is no less essential that the farmer should get an adequate return for what he grows, and it is no less essential—indeed, it is literally vital—that he and his wife and his children shall lead the right kind of life.

For this reason it is of the first importance that *the United States Department of Agriculture*, through which as prime agent the ideas the commission stands for must reach the people, *should become without delay, in fact, a department of country life*, fitted to deal not only with crops, but also with all larger aspects of life in the open country.

THREE NEEDS OF COUNTRY LIFE.

From all that has been done and learned three great general and immediate needs of country life stand out:

First. *Effective coöperation among farmers to put them on a level with the organized interests with which they do business.*

Second. *A new kind of schools in the country which shall teach the children as much outdoors as indoors and perhaps more, so that they will prepare for country life and not, as at present, mainly for life in town.*

Third. *Better means of communication, including good roads and a parcels post, which the country people are everywhere, and rightly, unanimous in demanding.*

To these may well be added *better sanitation, for easily preventable disease hold several million country people in the slavery of continuous ill health.*

ORGANIZATION NECESSARY.

The commission points out—and I concur in the conclusion—that the most important help that the Government, whether National or State, can give is to show the people how to go about these tasks of organization, education and communication with the best and quickest results. This can be done by the collection and spread of information. One community can thus be informed of what other communities have done and one country of what other countries have done. Such help by the people's government would lead to a comprehensive plan of organization, education, and communication and make the farming country better to live in, for intellectual and social reasons as well as for purely agricultural reasons.

The Government through the Department of Agriculture does not cultivate any man's farm for him, but it does put at his service useful knowledge that he would not otherwise get. In the same way the National and State governments might put into the people's hands the new and right knowledge of school work. The task of maintaining and developing the schools would remain, as now, with the people themselves.

MONEY FOR EXPENSES ASKED.

The only recommendation I submit is that an appropriation of $25,000 be provided to enable the commission to digest the material it has collected and to collect and to digest much more that is within its reach and thus complete its work. This would enable the commission to gather in the harvest of suggestion which is resulting from the discussion it has stirred up. The commissioners have served without compensation, and I do not recommend any appropriation for their services, but only for the expenses that will be required to finish the task that they have begun.

To improve our system of agriculture seems to me the most urgent of the tasks which lie before us. But it can not, in my judgment, be effected by measures which touch only the material and technical side of the subject. The whole business and life of the farmer must also be taken into account. Such consideration led me to appoint the commission on country life. Our object should be to help develop in the country community the great ideals of community life as well as of personal character. One of the most important adjuncts to this end must be the country church, and I invite your attention to what the commission says of the country church and of the need of an extension of such work as that of the Young Men's Christian Association in country communities. Let me lay special emphasis upon what the commission says at the very end of its report on personal ideals and local leadership. Everything resolves itself in the end into the question of personality. Neither society nor government can do much for country life unless there is a voluntary response in the personal ideals of the men and women who live in the country.

PLEA FOR FARMERS' WIVES.

In the development of character the home should be more important than the school or than society at large. When once the basic material needs have been met, high ideals may be quite independent of income, but they can not be realized without sufficient income to provide adequate foundation, and where the community at large is not financially prosperous it is impossible to develop a high average personal and community ideal. In short, the fundamental facts of human nature apply to men and women who live in the country just as they apply to men and women who live in the towns. Given a sufficient foundation of material well being, the influence of the farmers and farmers' wives on their children becomes

the factor of first importance in determining the attitude of the next generation toward farm life. The farmer should realize that the person who most needs consideration on the farm is his wife. I do not in the least mean that she should purchase ease at the expense of duty. Neither man nor woman is really happy or really useful save on condition of doing his or her duty. If the woman shirks her duty as housewife, as home keeper, as the mother whose prime function is to bear and rear a sufficient number of healthy children, then she is not entitled to our regard. But if she does her duty she is more entitled to our regard even than the man who does his duty and the man should show special consideration for her needs.

I warn my countrymen that the great progress made in city life is not a full measure of our civilization, for our civilization rests at bottom on the wholesomeness, the attractiveness and the completeness as well as the prosperity of life in the country. The men and women on the farm stand for what is fundamentally best and most needed in our American life. Upon the development of country life rests ultimately our ability, by methods of farming requiring the highest intelligence, to continue to feed and clothe the hungry nations, to supply the city with fresh blood, clean bodies and clear brains that can endure the terrific strain of modern life. We need the development of men in the open country, who will be in the future, as in the past, the stay and strength of the nation in time of war and its guiding and controlling spirit in time of peace.

SPECIAL RECOMMENDATIONS OF THE COMMISSION.[1]

The commission enumerates eleven specific suggestions for Congressional action that have been sent to it, such as *the encouragement of land surveys, the establishment of a highway engineering service* to be at the call of the States, and *the enlargement of the Bureau of Education;* it also groups remedies under the general term of *an educative campaign to spread information* on the whole subject of rural life, *to quicken the sense of responsibility for diversifying farming* so as to preserve soil fertility and improve rural society, *to make more widespread the belief in the necessity of organization, to make more general the farmer's sense of responsibility for the welfare of the farm laborer,* and *to awaken among the people generally conscience in protecting and developing natural scenery and the attractiveness of the open country.* There are, however, three great movements which the commission calls fundamental. These are worthy of quotation in full:

I. *Taking stock of country life.*—There should be organized, as explained in the main report, under the Government leadership, a comprehensive plan for an exhaustive study or survey of all the conditions that surround the business of farming and the people who live in the country, in order to take stock of our resources and to supply the farmer with local knowledge. Federal and State governments, agricultural colleges and other educational agencies, organizations of various types, and individual students of the problem, should be brought into coöperation for this great work of investigating with minute care all agricultural and country life conditions.

II. *Nationalized extension work.*—Each State college of agriculture should be empowered to organize as soon as practicable a complete department of college

[1] From the Outlook, February 20, 1909.

extension, so managed as to reach every person on the land in its State with both information and inspiration. The work should include such forms of extension teaching as lectures, bulletins, reading courses, correspondence courses, demonstration, and other means of reaching the people at home and on their farms. It should be designed to forward not only the business of agriculture, but sanitation, education, home-making, and all interests of country life.

III. *A campaign for rural progress.—We urge the holding of local, State, and even national conferences on rural progress,* designed to unite the interests of education, organization, and religion into one forward movement for the rebuilding of country life. *Rural teachers, librarians, clergymen, editors, physicians, and others may well unite with farmers in studying and discussing the rural question in all its aspects.* We must in some way unite all institutions, all organizations, all individuals having any interest in country life into one great campaign for rural progress.

The commission recognizes the great value of existing organizations such as libraries, agricultural societies, the Young Men's Christian Association, and, above all, the rural churches; and it urges the development of greater coöperation among them. It adds that there is a great call for leaders among farmers, rural teachers, and the rural clergy. The report and the message ought to have the widest circulation, not only among the dwellers in the country but even more especially among the people of the cities. It is the urban citizen who is in the greatest need of information on the subject; and he is in fact as much concerned with proper rural conditions as the man on the farm.

THE ANNUAL AGRI-HORTICULTURAL SHOW OF PERAK.[1]

A most successful agri-horticultural show took place at Kuala Kangsar in Perak, organized by an energetic committee, and had the advantage of patronage and help from his highness the Sultan of Perak and the British resident. The show was very representative of the best products of agriculture in Malaya, as well as native arts and crafts. It had an additional interest in being a more typical Malayan show than those held in towns of cosmopolitan character, and its success was to a great extent due to the efforts of Malayan gentlemen, especially the Dato Sri Adika Raja, I. S. O., and the Dato Stia Raja.

His excellency the high commissioner, who was in residence at Kuala Kangsar, performed the opening ceremony which was attended by their highnesses the Sultans of Perak, Johore, and Selangor. An interesting exhibition from Brunei of the characteristic metal work of that country was brought over by native chiefs escorted by Mr. Roberts, of the public works department.

These shows, especially when well attended as the Kuala Kangsar show was by large numbers of natives engaged in agricultural pursuits, spread the desire to improve different cultivations. At the same time they are of value to those engaged in helping the natives by allowing them to see in what direction help may best be given.

Seeds of prize fruits are obtained from the exhibitions and form a basis upon which the work of improvement of fruits by selection and other methods is carried on by the department.

Mr. T. W. Main,[2] superintendent of government plantations, Perak, speaking of the agri-horticultural show says:

> The agri-horticultural show was held at Kuala Kangsar on the 9th, 10th, and 11th of August. I acted as honorary secretary. The show was a great success and showed a profit of $712.28. These shows increase in excellence year by year. The quality of the exhibits was much in advance of those of former years. Perak exhibits were particularly good in rubber, fruit, and padi. Perak exhibitors carried off 150 first prizes, 125 seconds, and over 50 thirds, besides several silver cups, medals, and diplomas. The usual display of English vegetables from the Larut Hill Gardens was staged and attracted great attention.

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[1] From the report of the director of agriculture, Federated Malay States, in agricultural bulletin of the Straits and Federated Malay States, Vol. VII, No. 11, November, 1908.

[2] Mr. T. W. Main, in annual report for 1907.

"All the principal industrial and social centers of the state are now approachable by good roads, and in most instances also by railway, and whether the traveler chooses to enter Perak by way of Penang from the north, Teluk Anson from the south, or Port Weld in the center, he will find facilities for passing rapidly and easily to almost any part of the state which he may desire to visit. Communication with Penang is maintained by steam ferry from that port to Prai in Province Wellesley, and thence by railway twice daily, and the vessels of the Straits Steamship Company run between Teluk Anson and Singapore about three times a week, touching en route at the ports of the southern states.

"The town of Kuala Kangsar, which is situated upon a most picturesque stretch of the Perak River, is the place of residence of his higness the Sultan, for whom an "astana" or palace of imposing appearance and dimensions was erected a few years ago at the cost of the state. He has since built two almost equally imposing structures out of his private purse." (From H. Conway Belfield's Handbook of the Federated Malay States.)

AGRICULTURAL CONDITIONS IN MARINDUQUE.

By A. F. Byars, *Agricultural Inspector.*

The Island of Marinduque, a subprovince of Tayabas, while only about one-third the size of Rhode Island, the smallest State in the Union, has almost as many geographical features as a continent. Her hills, mountains, rivers, plains, and bountiful natural resources offer opportunities for great agricultural development. In some of the mountains are found such minerals as lead, silver, and gold. Three Americans, who are at present engaged in mining in one of the barrios of Torrijos, claim to have discovered rich deposits of ore. The forests contain a large variety of fine cabinet woods which, while not found in very great quantities, are yet quite valuable.

As yet there are very few good roads in the island; but bancas and sailboats furnish easy transportation along the coast, while the port of Boac and the landlocked harbor of Santa Cruz offer good anchorages for steamers plying between Manila and southern ports.

Products and soils.—Generally speaking the soil of Marinduque—a shaley clayey loam on the mountains and hillsides, a black alluvial loam, calcareous sandy loam, or sand in the valleys and along the coast—is well adapted to the extensive growth of coconuts, abaca, rice, and numerous other crops of less importance. In Boac a large per cent of the cultivated land is planted to coconuts; in Torrijos to abaca, and in Gasan and Santa Cruz the areas of coconuts and abaca are about equal. (See map.) Considerable rice is grown in all four towns of Marinduque, but not enough for home consumption.

A few of the coconut trees are used for making "tuba," and a very small amount of the abaca is used in weaving "sinamay," a coarse native cloth; but copra and Manila hemp form by far the chief articles of export. The abaca is stripped, dried, and baled; most of the coconuts are made into copra and in some cases the oil is extracted before shipping. Anything that will increase the production of copra, abaca, and rice will add greatly to the wealth of the Island.

BETTER METHODS OF CULTIVATION NECESSARY.

COCONUTS.

Selection and care.—At present many of the groves are in a half-wild state; practically no care is given them until they begin to bear and then little more is done than to gather the nuts. Little thought is given to the improvement of the groves; trees are often less than 4 meters apart where a distance of 9 meters would almost double the yield. Some of the farmers have found the value of keeping their groves free from undergrowth and are burning the trash and giving their trees more room to spread. For best results only large well-matured thick-meated nuts should be planted. These nuts should be lowered to the ground by means of a rope, and not dropped from the tree, as the jar incurred by the fall weakens or kills the embryo plant. After remaining in the sprouting bed for five or six months only the strong healthy plants should be selected for transplanting to the place of permanent growth which should be previously prepared by thorough plowing. Young groves should be cultivated frequently to keep down weeds and retain moisture.

It is a good idea to plant some crop such as "camotes" or corn between the rows for the first two or three years. Even old groves should be cultivated once or twice each year.

Enemies.—As a preventative to the spread of disease and injurious insects nothing equals the cutting down of all dead and dying trees and the collecting in heaps of all dead trunks, leaves, and trash and burning them. These things offer most advantageous places for the breeding of insects and plant diseases. A close watch in the groves for the rhinoceros beetle (*uang*), which bores its way into the bud, will be the means of saving many trees. This insect should be removed from its hole by means of a piece of pointed wire having a barb, or killed by pouring carbon bisulphide into the hole and closing it up with mud. Occasionally the base of the leaves should be cleaned of all collected trash so as to keep out rats. Some means should be devised for destroying the crow (*whac*), which has become quite a pest in this island and destroys large quantities of young nuts, also corn and other crops. Use of poisoned bait would probably be the most effective means of ridding the country of these pests. A practice prejudicial to the groves is that of cutting notches or steps in the trunks of the trees as these places are very susceptible to the attacks of insects and fungous diseases. It would be better to detach the nuts by means of a curved knife fastened to the end of a sectioned bamboo pole as is practiced in the Province of La Laguna.

ABACA.

Selection and stripping.—At times like this, when the price is very low, only those varieties of abaca which yield the best fiber should be

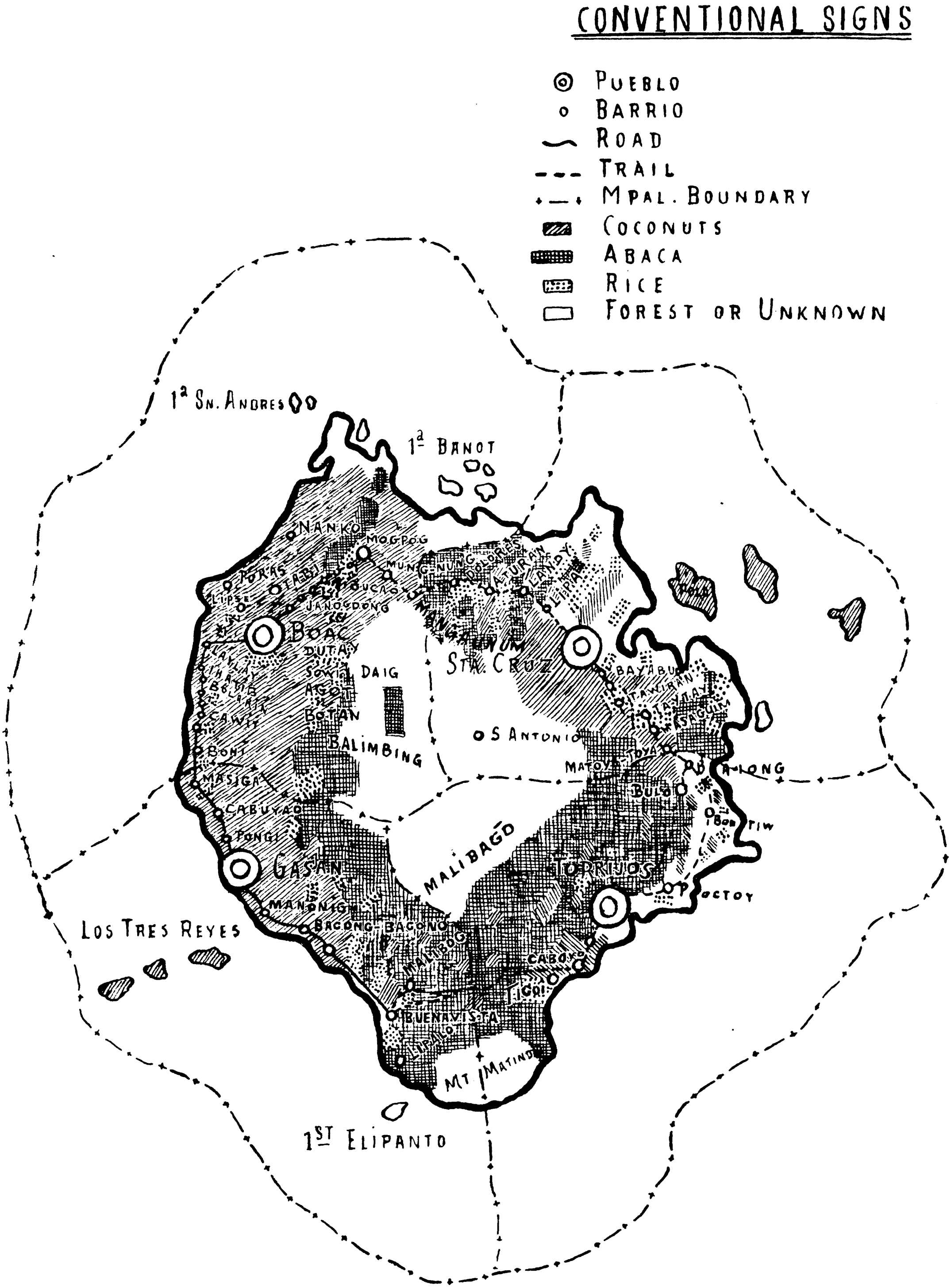

PLATE I. MAP OF THE ISLAND OF MARINDUQUE SHOWING DISTRIBUTION OF AGRICULTURAL PRODUCTS.

grown. Of the crop that has been gathered during the past several months in the municipality of Gasan 10 per cent or less was first-class hemp; about 50 per cent was second-class and 20 to 30 per cent was third-class. By a continued and careful selection of sprouts from the best stalks when transplanting a variety could be produced which would yield a much higher percentage of first-class fiber. One of the practices that lowers the selling price of a sample of hemp more than anything else is that of failing to carefully and properly strip and clean the fiber. Not only should the fiber be strong, long, and white, but it should be thoroughly cleaned.

There are many uncultivated areas around the towns of Gasan and Torrijos that could be profitably planted to abaca. In these sections it does well where a little care and cultivation is given. It grows well on the stony hill and mountain sides which are too rough for any other crop.

RICE AND OTHER FOOD CROPS.

The most vulnerable point in the agricultural practices of Marinduque, in fact of a great part of the whole Philippine Archipelago, is its failure to produce sufficient food crops. This deficiency is not due to lack of fertile soils, favorable climatic conditions, or to a scarcity of food plants which thrive. The people have not yet learned the value of a diversification of crops. With the development of irrigation facilities, afforded by the several mountain streams and proper cultivation, enormous crops of rice could be produced in the fertile valleys. A perfected system of irrigation would make possible two crops of rice each year over a large area.

CORN.

Considerable quantities of corn are now grown on the "Tres Reyes" islands off the southwest coast. Corn could be produced more extensively in Marinduque—a crop of corn being raised after a crop of rice during the dry season.

CACAO.

In nearly every barrio a few cacao trees are grown. These seem to be remarkably free from insects and diseases and there is no doubt but what cacao could be made an export crop of the island.

VEGETABLES.

Sweet potatoes do well in Marinduque and this crop could be easily increased. Several varieties of peas, two kinds of squashes, peppers (which grow wild everywhere), tomatoes, onions, and other vegetables are to be found growing all over the island, and an ample quantity of all of these could be produced for domestic use.

FRUITS.

Mangoes, bananas, oranges, chicos, duhats, and innumerable other fruits, now growing half wild, could with cultivation and selection be greatly improved.

STOCK RAISING.

The hillsides around Santa Cruz and Torrijos are admirably suited to stock raising, having grass all the year round and an abundant supply of fresh water. However, more care should be given to breeding—only the best animals should be used for this purpose.

Until the inhabitants learn the full meaning of the word *quarantine* in regard to infectious and contagious animal diseases they can not succeed in this industry. It would be well for the provincial board to pass a rigid quarantine law and enforce it; until this has been done no veterinarian can hope to stop the depredations of surra and rinderpest.

In conclusion, the Island of Marinduque is, indeed, rich in natural resources, including a fertile soil, abundant water supply, forests of valuable woods, and climatic conditions favorable to the growth of varied crops. With intelligent cultivation of her soil the employment of scientific methods of crop cultivation and the building of good roads, Marinduque can be made to blossom like a garden.

AN ORDINANCE TO PREVENT THE INTRODUCTION OF PLANT PESTS INTO THE STRAITS SETTLEMENTS.[1]

Nearly all of the colonies especially those of the tropics now have regulations as to the importation of plants or seeds from countries in which there is any insect or plant pest affecting plants, through which the disease is likely to be introduced. These regulations are intended of course to protect cultivated plants only and are usually, but not always, enforced when there is a definite disease affecting an extensive cultivation in the country of the would-be exporter, and the same cultivation is without the disease in the country to which it is intended to export the plant. Thus Jamaica for many years prohibited the importation of any living plants of whatever kind from any country, in which there was cultivated coffee affected with *Hemileia vastatrix,* and thus kept the disease out of the country for a considerable period. There are diseases which no man can possibly prevent the invasion of as the distances which spores of fungi can float on the wind is very great and in countries at all contiguous they can drift across if the wind is suitable. The bee-hawk moth, the caterpillar of which was so destructive to the coffee some years ago in Selangor, is also a very long-flying insect. It was found to be quite abundant in Christmas Island over 200 miles from the nearest land it could have come from.

But these are rather exceptional cases and most plant diseases appear to be accidentally imported by man. In the interest therefore of the great areas of cultivations of plants nowadays, it is essential to prevent as much as possible any disease that has unfortunately appeared in one country from invading another.

Hitherto there has been no ordinance permitting the colony to refuse to allow diseased plants to be imported, and it became clearly desirable that it should have this power. Hence at the suggestion of the director of gardens the following ordinance has been passed.

[STRAITS SETTLEMENTS ORDINANCE NO. XII, 1908.]

An ordinance to prevent the introduction into the colony of pests and insects destructive to trees, plants and crops.

It is hereby enacted by the governor of the Straits Settlements with the advice and consent of the legislature thereof as follows:

1. This ordinance may be cited as "The Destructive Pests Ordinance 1908."

2. The governor in council may from time to time make such orders as may to the governor in council appear expedient for preventing the introduction into

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[1] Agricultural Bulletin of the Straits and Federated Malay States, Vol. VII, No. 12, December, 1908.

the colony of any insect, fungus, or other pest, destructive to agricultural or horticultural crops, to trees or plants, and for preventing the spreading in the colony of any such insect, fungus, or other pest.

3. Any such order may prohibit or regulate the landing in the colony of any tree or plant, or the leaves, branches, stems, roots, seeds, or fruit of any tree or plant, or any vegetable substance or other article, the landing whereof may appear to the governor in council to be likely to introduce such insect, fungus, or other pest, and may direct or authorize the treatment or destruction of any such article, if landed. Any such order may also direct or authorize the treatment, removal, or destruction of any crop, tree, plant, or substance on which the insect, fungus, or other pest in any stage of its existence is found, or by means of which it may appear to the governor in council to be likely to spread, and the entering on any lands for the purpose of such treatment, removal, or destruction, or for the purpose of any examination or inquiry authorized by the order, or for any other purpose of the order.

4. The governor in council may from time to time make orders for the payment of compensation in respect of any crop, tree, plant, or other substance destroyed under the provisions of this ordinance.

5. Any person acting in contravention of any order under this ordinance shall be guilty of an offense, and shall be liable upon conviction to a fine not exceeding five hundred dollars.

Passed this 11th day of September, 1908.

EXTRACT FROM THE REPORT OF THE GOVERNMENT ENTOMOLOGIST, HAWAII, FOR NOVEMBER AND DECEMBER, 1908.[1]

INSPECTION.

We boarded 55 vessels and found matter subject to our inspection on 34 of them. The result is shown briefly in the following table.

Table of inspection.

Disposal with principal causes.	Lots.	Parcels.
November:		
Passed as free from pests	569	13,150
Fumigated for scale bugs and white fly before releasing[a]	13	24
Ordered potatoes returned on account of scab	2	298
Ordered apples and pears returned on account of greedy scale	3	532
Burned on account of scale and rot	2	2
Burned turnips and horse-radish roots on account of cabbage maggot	2	4
Burned fruit from the Orient because prohibited by your regulation	14	17
Burned taro, sweet potatoes, and garlic from the Orient because of parasitic fungus on first and insect pests on last two	3	10
Total	608	14,037
December:		
Passed as free from pests	759	16,439
Fumigated for large variety of mealy and scale bugs, white fly and evidence of borer	15	41
Mangroves from Manila picked over one by one for a variety of most dangerous pests, then fumigated before releasing	1	3
Bamboo plants from Japan treated likewise	1	1
Seed potatoes treated with formalin to kill scab	1	35
Potatoes ordered returned on account of scab and soil	7	813
Apples ordered returned on account of greedy scale	2	115
Burned for a variety of pests	7	13
Total	793	17,460

[a] One of these was a wardian case of mango plants from Honolulu bound for another island. To prevent spread of possible pests fumigated at request of shipper.

MISCELLANEOUS.

Dock laboratory and quarantine room.—The laboratory on the Oceanic dock was completed early in December and is a credit to the service, which it aids in a decidedly substantial way. We had repeated occasion to use it to advantage and with success. We also have there now a sign proclaiming to the world the mission of those structures on the dock.

Fumigatory exhaust.—Hitherto, in order to ventilate the fumigatories the doors were opened and the gases discharged directly onto the dock. This was dangerous to the operators, and other people also when operated on steamer days. An appeal was made to the superintendent of public works and he kindly had a 4-inch gate-valve and necessary piping put in, enabling us to exhaust the noxious fumes outside and above the dock. This was installed on the Oceanic Dock.

[1] The Hawaiian Forester and Agriculturist, Vol. VI, No. 1, January, 1909.

REPORT ON RICE CULTIVATION IN ZAMBALES AND PANGASINAN.

By SILVERIO APOSTOL, *Agricultural Assistant.*

Samples were gathered in that part of Pangasinan east of the railroad line, namely, from the towns of Villasis, Asingan, Tayug, San Quintin, Binalonan, and Pozorrubio. This section of the province is generally flat and low, and rice is practically the only crop grown in appreciable quantities. A little tobacco is also cultivated, especially in the municipalities of Manaoag, San Jacinto, and Mangaldan. Following the rice crop in Asingan about 70 per cent of the total area from which rice is harvested is planted with a kind of bean known as "mongo." Asingan, it may be noted, is the best irrigated of all of the towns in this section and it is said that about 70 per cent of all of the rice lands therein do not have to depend very much on rainfall for water. The mongo is grown after the rice crop during the latter half of February or early in March.

SELECTION.

Apparently the farmers of Pangasinan and those of Zambales have different ideas in making their selection of rice seed. The rice grown in Zambales is mostly awnless, while in Pangasinan awned rice is grown almost exclusively and there is comparatively little awnless rice raised except for feeding chickens. Thus the expense and work of thrashing awnless rice is avoided in Pangasinan; harvesting awned rice, however, demands more labor, as the process of cutting it is very tedious.

Awned rice shatters or shells less easily than the awnless varieties. Besides, the threshing is done by animals (carabaos, cattle, or horses) tramping off the grain, and the presence of the awn or beard, which hurts the feet of the animals, makes threshing more difficult.

METHOD OF CULTIVATION.

The method employed in growing rice in Pangasinan is practically the same as that used in Zambales, La Laguna, and other parts of the Islands.

Lowland rice.—In the absence of artificial irrigation, the work is begun with the advent of the rainy season. During the latter part of April and the whole of May the seed beds are prepared and from the last half of July through the first half of September, the transplanting is done. The ground for the seed bed is plowed and harrowed three or

four times until the soil is pulverized enough for good germination. It is then divided into plots by running the plow deeply at intervals of about eight feet, after which the seed is sown rather thickly and covered thinly with soil from the edges of the plots.

The above method of seeding is practiced more in Zambales than in Pangasinan, as in the latter province the farmers choose a higher place for their seed beds and drill the seed instead of sowing it. Three men are generally necessary to do the work; one man with a large toothed instrument like a wooden fork makes the holes, and two men follow him to distribute the seed, leaving from twenty to forty grains in each hole. The holes made by the teeth of this instrument are 3½ to 4 inches apart, 3 inches deep, and about 1½ inches in diameter.

TRANSPLANTING.

When the seed acquires a height of about 17 inches, at which time it is about five weeks old, rain or water being sufficient, it is pulled up carefully and after washing off the adhering soil it is transplanted to a field which has been previously plowed once and harrowed. Generally, the harrowing is partly done the day before, and partly on the day of transplanting, by hand. One, two, or three of the young plants make a hill. The base or root is introduced into the mud by the thumb and first finger, and left there. The hills are about 8 inches apart. The Ilocanos use a short pointed stick to assist in making the hole for the young plant. Having transplanted his rice, the farmer generally leaves the rest to Divine Providence, doing nothing more—often not even inspecting it—until the time of harvest. If he gathers a poor crop, he sadly satisfies himself by saying, "Oh, I have bad luck this year!"

Highland rice.—The land is plowed once in April and again in May; after it has been rolled and harrowed the seed is sown broadcast. No further cultivation or weeding is done to the growing crop before harvesting.

Where the land can not be plowed it is cleared of bushes and small trees with the help of fire, and the seed is then drilled in by means of sharpened or pointed sticks, with which one man makes little holes in the ground and another follows him with the seed, leaving from one to six grains in each hole.

Evidently, the cost of growing highland rice is much less than that of growing the lowland varieties.

HARVESTING.

Harvesting awned rice, as previously stated, is a very tedious process. The spikes are cut off one by one, with a hand instrument consisting of a handle and blade, about 10 or 12 inches below the lowest whorl or spikelet. The spikes are then tied up with twine into bundles about 3¼ inches in diameter. One person generally cuts an average of from 28

to 36 bundles per day, about 5 or 6 "manojos." One "manojo" weighs from 25 to 32 pounds when dry. The harvesting is done on shares and generally one-fifth goes to the harvester. One hectare of the average rice land of Pangasinan produces normally about 135 "manojos" of rice.

COST OF PRODUCTION.

The cost for farm labor, especially transplanters, varies from 20 centavos to 50 centavos per day, while that for one man with a carabao and a plow or harrow varies from 50 centavos to ₱1.50 per day. It is customary in Pangasinan for the owner to provide breakfast and dinner for the workers whenever the work involves one day's labor. In the case of harvesting on shares the harvester furnishes his own meals. It takes from five to seven men to plow one hectare of land, it requires about six "manojos" of seed, ten to twelve persons to transplant, and thirty to thirty-five to harvest the crop in one day. Generally, the growing of one hectare of lowland rice in Pangasinan, exclusive of harvesting, involves an average expense of about ₱22.50.

VARIETIES RAISED IN PANGASINAN.

According to the reports received by the Bureau of Agriculture there were 17,000 hectares of land in Zambales devoted to rice raising which produced 567,000 cavans of rice in 1908. In response to the request of the Director of Agriculture the following varieties of rice have thus far been reported from the towns named in Pangasinan:

Table showing varieties of rice grown in Pangasinan.

Towns in Pangasinan and varieties in order of their importance.	Highland (H) or lowland (L).	Glutinous (G) or nonglutinous (NG).	Bearded (B) or not bearded (NB).	Color of cuticle.	Days to maturity.	
					From sowing.	From transplanting.
Santa María:						
Caviteña	L	NG	B	White	180	150
Mimis	L	G	NB	do	180	150
Presentado	L	G	B	do	120	90
Sambilak	L	NG	B	do	150	120
Macaanay	L	NG	B	do	210	180
Macanista	L	G	B	do	215	180
Buric	L	NG	B	do	180	150
Guinguin-awa	L	NG	B	do	150	120
Binacroy	L	NG	B	do	180	150
Mabolo	L	NG	B	Red	180	150
Cayading	L	G	B	White	180	150
Binalayang	L	NG	B	do	180	150
Matayosa	L	NG	B	do	215	180
Ganado	L	NG	B	do	215	180
Bal-latinew	L	NG	B	Black	210	180
Bul-lilising	L	NG	B	White	210	180
Melmel	L	NG	B	do	310	280
Murmuray	L	NG	B	do	240	210
Linagat	L	NG	B	do	210	180
Mambog	L	NG	B	do	210	180
Minantica	L	NG	B	do	210	180
Pallacate	L	NG	B	do	210	180
Candelaria	L	NG	B	do	210	180
Moñosa	L	NG	B	do	210	180
Pinili	L	NG	B	do	210	180
Quinastila	L	NG	B	do	210	180
Ortao	L	NG	B	do	210	180
Almisque	L	NG	B	do	220	190

Table showing varieties of rice grown in Pangasinan—Continued.

Towns in Pangasinan and varieties in order of their importance.	Highland (H) or lowland (L).	Glutinous (G) or non-glutinous (NG).	Bearded (B) or not bearded (NB).	Color of cuticle.	Days to maturity.	
					From sowing.	From transplanting.
Calasiao:						
Caviteña	H	NG	B	White	110	
Macarañag	H	NG	B	do	90	
Binondoc	H	NG	B	do	100	
Macunting	H	NG	B	do	100	
Quinaturay	H	NG	B	do	100	
Binoloney	H	NG	NB	Red	110	
Malinis	H	NG	NB	White	110	
Magamang	H	NG	B	Red	110	
Pinili	L	NG	B	White	140	100
Damasco	L	NG	B	do	120	90
Saruyao	L	NG	B	do	120	90
Ubanan	L	NG	B	do	120	90
Salayusay	L	NG	B	do	120	90
Limpulet	L	NG	B	do	140	100
Binolalaqui	L	NG	B	do	140	100
Aculao	L	NG	B	Red	110	80
Goyoran	L	G	B	White	110	80
Binotayon	L	G	NB	do	110	80
Nilangca	L	G	B	do	120	90
Binmaley:						
Caviteña	H	NG	B	Red	270	180
Ubanen	H	NG	B	White	270	180
Magonting	H	NG	B	do	270	180
Batalinew	H	NG	B	Brown	270	180
Pinaculat	H	NG	B	White	270	180
Maneclang	H	NG	B	Red	270	180
Saba	H	NG	B	White	270	180
Salayosay	H	NG	B	do	270	180
Linarocot	H	NG	B	do	270	180
Ansaquet	H	G	B	Brown	270	180
Santa Barbara:						
Ubanan	H	NG	B	White	140	110
Binalalaqui	H	NG	B	do	145	115
Caviteña	H	NG	B	Red	130	100
Macarañag	H	NG	B	White	75	130
Malinío	H	NG	NB	do	80	
Mismis	L	NG	B	do	160	130
Sipit	L	NG	B	do	142	112
Quinatoray	H	NG	B	do	60	
Bangol	H	NG	B	do	65	
Lamparan	H	NG	B	do	65	
Calaguiquing	H	G	B	do	65	
Inagamang	H	G	B	do	70	
Binondoc	H	NG	B	do	70	
Malingao	H	NG	B	do	70	
Brea	L	G	NB	do	110	80
Caclumba	L	NG	B	do	115	85
Daloson	L	NG	B	do	120	90
Sambilar	L	G	B	Red	120	90
Matanorang	L	NG	B	Reddish-white.	130	100
Minaloco	L	NG	B	White	130	100
Bansoroy	L	NG	B	do	130	100
Macalonit	L	NG	B	do	130	100
Binolaney	L	NG	NB	do	130	100
Sinoan	L	G	B	do	135	105
Batolinew	L	G	B	Red	130	100
Berico	L	NG	B	White	140	110
San Vicente	L	NG	B	do	140	110
Linaclang	L	NG	B	do	140	110
Corrales	L	G	B	Red	140	110
Simpolet	L	NG	B	White	142	112
Cayabang	L	NG	B	do	142	112
Salayosay	L	NG	B	do	142	112
Minantica	L	NG	B	do	142	112
Labong	L	G	B	do	142	112
Quinastila	L	NG	B	do	145	115
Binara	L	NG	B	do	145	115
Acolao	L	G	B	do	145	115
Sinullá	L	G	B	do	145	115
Piñas	L	NG	B	do	155	125
Boncol	L	NG	B	do	160	130

Table showing varieties of rice grown in Pangasinan—Continued.

Towns in Pangasinan and varieties in order of their importance.	Highland (H) or lowland (L).	Glutinous (G) or non-glutinous (NG).	Bearded (B) or not bearded (NB).	Color of cuticle.	Days to maturity.	
					From sowing.	From transplanting.
San Nicolás:						
Pinili	H	NG	B	White	110	----------
Ganado	L	NG	B	do	200	170
Obanan	L	NG	B	do	160	130
Mandigorin	L	NG	B	do	180	150
Melmel	L	NG	B	do	210	180
Candelaria	L	NG	B	do	220	190
Calantangan	L	NG	B	do	210	180
Mormoray	L	NG	B	do	210	180
Banata	L	NG	B	do	210	180
Principe	L	NG	B	do	200	190
Manteca	L	NG	B	do	180	150
Cayaring	L	NG	B	do	180	150
Boncol	L	NG	B	do	110	150
Almisqui	L	NG	B	do	200	190
Dalosón	L	NG	B	do	200	190
Enero	L	G	B	do	200	190
Ortoc	L	NG	NB	do	180	150
Mambog	L	NG	B	do	180	150
Mabolo	L	NG	B	Red	150	120
Macanini	L	G	B	White	150	120
Castaño	L	G	B	do	150	120
Mimis	L	NG	NB	do	150	120
Lanca	L	NG	B	do	150	120
Impon	L	NG	B	do	150	120
Bal-lilising	L	G	B	do	150	120
Batolinew	L	G	B	Red	150	120
Bayabas	L	G	NB	White	150	120
Sinaba	H	G	B	do	110	----------
Bolic	H	NG	B	do	110	----------
Catoray	H	----------	B	do	110	----------
Calangiquing	H	G	B	do	110	----------
Bangol	H	NG	B	do	110	----------
Cosimay	L	NG	B	do	180	150
Bani:						
Ganado	L	G	B	do	240	150
Castila	L	NG	B	do	240	150
Mantica	L	G	B	do	240	150
Bandera	L	NG	B	do	240	150
Mantenido	L	G	B	do	240	150
Macaranag	L	G	B	do	240	150
Payapay	L	G	B	do	240	150
Capigued	L	NG	B	Red	210	150
Baticang	L	NG	B	White	210	150
San Juan	L	G	B	do	210	120
Bansoroy	L	NG	B	do	210	120
Quiriquiri	L	NG	NB	do	210	120
Macan dingay	L	G	B	do	240	120
Bul-lilising	L	G	B	do	210	120
Castañeda	L	G	B	do	210	120
Batalinew	L	G	B	Black	210	120
Ibali	L	G	NB	White	210	120
Sinampablo	L	G	NB	do	210	120
Balasang	L	G	B	do	240	150
Bangrae	L	NG	B	do	240	150
Grana	L	NG	B	Red	240	150
Binada	L	NG	B	White	240	150
Balayang	L	NG	B	do	240	150
Sal-laguid	L	NG	B	do	240	150
Salayusay	L	NG	B	do	240	150
Azucena	L	NG	B	do	240	150
Caviteña	L	NG	B	do	240	150
Mapursac	L	NG	B	do	240	150
Santa Cruz	L	NG	B	do	240	150
San Fabian:						
Pinili	L	NG	B	do	195	165
Sambilac	L	NG	B	do	195	165
Malaca	L	NG	B	do	195	168
Cristal	L	NG	B	do	195	165
Ubanen	L	G	B	do	195	165
Quinaballero	L	NG	B	do	195	165
Mambog	L	NG	B	do	150	110
Tayaring	L	NG	B	do	150	110
Batolinew	L	G	B	Red	150	110
Mariquet	L	G	B	White	150	110
Romero	L	NG	NB	do	150	110

Table showing varieties of rice grown in Pangasinan—Continued.

Towns in Pangasinan and varieties in order of their importance.	Highland (H) or lowland (L).	Glutinous (G) or nonglutinous (NG).	Bearded (B) or not bearded (NB).	Color of cuticle.	Days to maturity.	
					From sowing.	From transplanting.
San Fabian—Continued.						
Oldog	L	NG	NB	White	150	110
Bolic	H	NG	B	do	100	60
Rosquitis	H	NG	B	Red	100	60
Payos	H	NG	B	do	100	60
Sinamvicente	H	NG	B	do	100	60
Grana	H	NG	B	do	100	60
Anda:						
Coliit	H	NG	B	White	180	----------
Amigay	H	NG	B	do	180	----------
Matayosa	L	NG	B	do	210	180
Quiriquiri	L	----------	NB	do	210	180
Isla	H	----------	B	do	180	----------
Macoloney	L	----------	B	do	210	180
Binangar	L	----------	B	do	210	180
Bangos	L	----------	B	do	210	180
Bandera	L	----------	B	do	210	180
Marilis	L	----------	B	Red	210	180
Bacnotan	L	----------	B	White	210	180
San Carlos:						
Momalit	H	NG	B	do	240	210
Mantica	H	NG	B	do	240	210
Binacloy	H	NG	B	do	240	210
Payapang	H	NG	B	do	240	210
Ganado	H	NG	B	do	240	210
Malaca	H	NG	B	do	240	210
Principe	H	NG	B	do	240	210
Sagat	H	NG	B	do	240	210
Quinastila	H	NG	B	do	240	210
Caviteña	H	NG	B	do	180	150
Castaño	H	NG	B	do	180	150
Inanteresa	H	NG	B	do	180	150
Sambilac	H	NG	B	do	180	150
Sinarocot	H	NG	B	do	180	150
Salayusay	H	NG	B	Red	180	150
Macansuana	H	NG	B	White	180	150
Romero	H	NG	B	do	180	150
Binondoc	H	NG	B	do	160	130
Malogtoc	H	NG	B	do	160	130
Macatlong bulan	H	NG	B	do	160	130
Casibong	H	G	B	do	180	150
Condiman	H	G	B	do	180	150
Goyoran	H	G	B	do	180	150
Bria	H	G	NB	do	180	150
Batayong	H	G	NB	do	180	150
Natividad:						
Pinili	H	NG	B	do	90	----------
Sampadon	H	NG	B	do	90	----------
Macanene	L	NG	B	do	----------	120
Macan	L	NG	B	Red	----------	120
Sambilac	L	NG	B	do	----------	120
Mambog	L	NG	B	White	----------	120
Bal-latinao	L	G	B	Red	----------	120
Candelaria	L	NG	B	White	----------	180
Bongcol	L	NG	B	do	----------	180
Ortoc	L	NG	NB	do	----------	120
Calangiquin	L	G	B	do	----------	120
Seda	L	NG	B	do	----------	120
Bul-lilising	L	G	B	do	----------	120
Ubanan	L	NG	B	do	----------	180
Melmel	L	NG	B	do	----------	180
Binalonan:						
Murmuray	L	NG	B	do	240	200
Pias	L	NG	B	do	240	200
Diquet a lacay	L	G	B	do	240	200
Batnang	L	NG	B	do	240	200
Autonia	L	NG	B	do	240	200
Contenido	L	NG	B	do	240	200
Ubanan	H	NG	B	do	195	----------
Ganado	H	NG	B	do	210	----------
Matayosa	H	NG	B	do	210	----------
Saba	H	NG	B	do	80	----------
Catlonbulan	H	NG	B	do	90	----------
Macapno	H	NG	B	do	180	----------
Solacosac	H	NG	B	do	180	----------
Quinatoday	H	NG	B	do	180	----------

Table showing varieties of rice grown in Pangasinan—Continued.

Towns in Pangasinan and varieties in order of their importance.	Highland (H) or lowland (L).	Glutinous (G) or non-glutinous (NG).	Bearded (B) or not bearded (NB).	Color of cuticle.	Days to maturity.	
					From sowing.	From transplanting.
Binalonan—Continued.						
Castaño	H	NG	B	White	195	
Ortoc	H	G	NB	do	195	
Bul-liliseng	H	G	B	do	195	
Sambilac	H	NG	B	Red	195	
Mimis	H	NG	B	White	195	
Macaanay	H	NG	B	do	195	
Binaroy	H	NG	B	do	195	
Seda	H	G	B	do	195	
Ballatinao	H	G	B	Red	195	
Cayading	H	G	B	White	210	
Capigued	H	G	B	do	210	
Bongcol	H	G	B	do	210	
Mendegurin	H	G	B	do	210	
Urbiztondo:						
Balolaqui	L	NG	B	do	140	
Mantica	L	NG	B	do	160	
Inomalit	L	NG	B	Red	140	
Malaca	L	NG	B	White	140	
Princesa	L	NG	B	do	140	
Romero	L	NG	NB	do	140	
Goyoran	L	G	B	Black	140	
Batalinew	L	G	B	do	140	
Alasan	L	G	B	Red	120	
Bato	L	G	NB	Black	120	
Inagamang	H	NG	B		120	
Caviteña	H	NG	B	White	120	
Magano	H	NG	B	do	120	
Bolu	H	NG	B		120	
Sambilac	H	NG	B	Red	120	
Alcala:						
Ganado	L	NG	NB	White	180	150
Matayosa	L	NG	NB	do	210	180
Payos	L	NG	NB	do	210	180
Princesa	L	NG	B	do	210	180
Castaño	L	NG	B	do	210	180
Ubanen	L	NG	B	do	210	180
Bul-lilising	L	NG	B	do	210	180
Binacal	L	NG	B	do	210	180
Caviteña	H	NG	B	do	150	
Ortoc	L	NG	NB	do	150	120
Quinatuday	H	NG	NB	do	180	
Mangasa	H	NG	NB	do	120	
Malaca	L	NG	B	do	210	180
Mantica	L	NG	B	do	180	150
Bal-lalinao	L	G	B	Red	180	150
Mimis	L	NG	NB	White	180	150
Binacroy	L	NG	NB	do	180	150
Daldal	L	NG	B	Red	150	120

BALANCE SHEET OF THE SELANGOR AGRI-HORTICULTURAL SHOW, 1908.

OFFICE OF SUPERINTENDENT OF
EXPERIMENT PLANTATIONS, FEDERATED MALAY STATES,
Kuala Lumpor, November 19, 1908.

SIR: I have the honor to forward herewith balance sheet of the agri-horticultural show held in Kuala Lumpor on the 10th, 11th, and 12th of August last.

I have the honor to be, sir, your obedient servant,

J. W. CAMPBELL,
Hon. Secretary, Agri-Horticultural Show.

Balance sheet.

RECEIPTS.		EXPENDITURES.	
Subscription, Federated Malay States government contribution	$2,000.00	Prizes, cups, and medals	$731.86
Subscription, Straits Settlements government contribution	2,000.00	Money awards	1,845.00
Subscription, private	3,342.00	Printing and advertising	391.77
Subscription for special prizes	533.37	Transport	262.72
Gate receipts	1,549.85	Band	25.00
Rent for trade space and bar	465.00	Gate expenses	131.40
Receipts from visitors	453.82	Postage and telegrams	51.31
Proceeds of sale of buildings	242.62	Expenses of housing visitors	687.75
		Cost of buildings and fencing	3,667.15
		Miscellaneous clerical services	66.00
		Miscellaneous coolies wages	52.75
		Miscellaneous petty expenses	346.57
		Balance in bank	2,327.40
Total	10,586.66	Total	10,586.66

EXTRACTS FROM THE REPORT OF THE DIRECTOR OF AGRICULTURE FOR THE FEDERATED MALAY STATES, 1907.[1]

The report of the third year's work of the department of agriculture in the Federated Malay States records progress made in various directions.

Libraries and Laboratories.—The arrangement and fitting of laboratories, library, and offices naturally occupied some time, and the government mycologist began the arranging and cataloguing of the books and pamphlets in the library. Much time is lost in answering inquiries or making investigations by the absence of a comprehensive catalogue which enables any notes on a technical subject to be found at once without searching through various books or pamphlets where the information is most likely to be found. The card catalogue system universally found to be best for such libraries has been adopted.

Government Mycologist.—Mr. W. J. Gallagher, the government mycologist, took up his appointment on the 4th of April. He devoted himself at first to arranging and cataloguing the library and making himself familiar with the botanical and agricultural conditions of the Federated Malay States. The appointment of a scientific man to devote himself to the study of the diseases of cultivated plants is one of the best forms of insurance of agricultural interest which can be adopted.

That such an official can at once produce a panacea for all or any diseases which are causing damage to the various cultivated plants of the country no one will expect, but that all diseases can be looked after from their earliest stages and studied *in situ*—the only way in which any knowledge can be gained—is of great value. The history of such work has shown that the investigation of diseases of plants has always led to methods being discovered for successfully combating each evil.

Malaya is especially fortunate in a climate which is unsurpassed for rapid growth of vegetation; but these exceptionally good conditions are also in some cases favorable to the prosperity of insect and fungal pests, and it is imperative that careful watch should be kept by all the cultivators so that the earliest signs of disease, to whatever cause due, may

[1] From the report of the Director of Agriculture, Federated Malay States, in Agricultural Bulletin of the Straits and Federated Malay States, Vol. VII, No. 11, November, 1908.

be brought to the notice of the department. Delays in the treatment of any disease are dangerous, and every year cases are reported in which, if preventive and curative measures had been taken earlier, a good deal of labor and expense would have been saved. All effective measures for the preservation of health, whether carried out by individuals or by the government, rest upon exact knowledge of the causes of the diseases and the effects they produce. The best time to investigate a disease of cultivated crops is the first time it is observed and not when it is found that great damage is being done.

The plots of camphor show that this plant will grow in Malaya at sea level with great vigor. My experience of this plant in Ceylon was entirely different, there the most vigorous plants were some thousands of feet above sea level, but the growth of the trees in Batu Tiga and Kuala Lumpor plots has been so extraordinarily rapid that there is no doubt of the suitability of this climate to the cultivation of this plant.

Agricultural acreages in the Federated Malay States, 1907, excluding padi and horticulture.

Acreage in—	Selangor.	Perak.	Negri Sembilan.	Pahang.	Total.
Coconuts	21,321	57,776	18,000	15,463	112,560
Rubber	61,552	46,167	17,656	860	126,235
Coffee	7,595	756	2,382	100	10,833
Other cultivations chiefly tapioca	1,604	10,270	261		12,135
Total	92,072	114,969	38,299	16,423	261,763

COCONUTS.

Inspectors of Coconuts.—Coconuts have had a prosperous year without any serious outbreak of disease, and the diseases which are already rife have been during the year successfully combated by the inspector of coconuts and his staff. It is not easy to estimate what damage would have been done to the coconut industry if the coconut preservation staff had not been in existence, and it is not, therefore, possible to give any idea as to the amount, no doubt very considerable, which this preventive and curative work has added to the wealth of the country.

Mr. T. C. Nock, assistant inspector of coconuts, took up his duties early in the year and has already proved the value of his appointment by the energy and interest he has displayed in his work. An increase over last year of about 7 per cent in the acreage of this staple industry shows that there is an appreciation of the profits which can be gained by the cultivation of coconuts.

This important branch of the agriculture of the Federated Malay States, covering at the end of last year 112,500 acres, is dealt with in detail in the report of the inspector of coconuts. During the past year,

owing to the drop in rubber prices, there has been a tendency to take an interest in the "Consols of the East" cultivation, and land has been taken up which will be planted with this easily cultivated and profitable palm.

RICE OR PADI.

The problems of rice culture have been of special interest. Long years of cultivation in many countries have evolved methods which must to a great extent command attention and carry weight because of the fact that they are the outcome of a process of selection of the fittest method. Though this fact should not deter from the desire to find how they can be still further improved, it gives to the problems in *padi* cultivation a different aspect from those with which we are faced in a new cultivation like rubber, with very little past history, and no experience wrapped up in tradition capable of being extracted and made useful.

The experiments carried on at Parit Buntar owe much of their success to the care of Mr. F. F. Faithfull, A. M. I. C. E., assistant engineer Krian Irrigation Works, who took the greatest interest in all the problems which it was hoped to solve and recorded with great care all the necessary data. He aroused the interest of the *padi*-planting Malayas in the neighborhood of the experimental plots and explained to them the purpose of the different experiments and the value of the results.

Irrigation.—The Federated Malay States government has spent a large sum of money in increasing the fertility of some 70,000 acres of excellent *padi* land by a comprehensive irrigation scheme, and it is important that all within that area, should enjoy not only the advantages of the regular water supply, but that their methods of cultivation should be such that these advantages can be reaped as bountifully as possible.

I have not been able to get accurate statistics as to the relative yields per acre outside and inside the artificially irrigated area, but all the observations I have made and all the data I could obtain point to the fact that the crop has been increased probably 30 to 40 per cent by the use of irrigation. The monetary value of this is easy to calculate.

Enemies of Padi.—The crops of *padi* all over the Federated Malay States were about average, except inside the irrigated area where they were greater than usual, and some areas near Kuala Kangsar which were badly attacked and damaged by rats. Mr. Gallagher kindly undertook an investigation as to methods of combating this ubiquitous pest, and his preliminary experiments with carbon bisulphide were most encouraging. They will be continued when the next *padi* crop is planted, and it is probable that this method may prove an effective and practical way of ridding the *padi* planter of one of his constant and expensive enemies.

With regard to other enemies of *padi,* eelworms and fungi—more insiduous because less easily detected, but none the less detrimental—

these pests are automatically lessened within the irrigation area by the regular application of water and uniform times of letting off the water and drying the plants above ground. Where the plants are left too long in their young and tender condition without water they are open to the attacks of certain insect pests, and when they are kept too long growing in water other pests are enabled to thrive. In addition to this the value of the power of at any time drying or flooding the *padi* fields is in itself an admirable weapon against diseases.

Padi Experiments.—The following table shows the results of last year's experiments, the chief object of which was to determine the question as to how many plants per "perdu"—i. e., group of young plants put in one hill—and how many hills or "perdu" per acre give the largest yield. The seed crop was weighed and measured and the straw was weighed. It is too soon to draw definite conclusions until these experiments have been continued and expanded for some little time.

Padi experiments, Krian, 1907.

Letter of plot.	Variety planted.	Date of planting in nursery.	Date of transplanting in nursery.	Date of final planting in field.	Average number of plants per "perdu."	Distance between "perdu"	Number of "perdu" per acre.	Number of plants per acre.	Date of reaping.	Amount of crop per acre in gantong=1 gallon.	Weight of crop per acre (pounds).	Weight of straw per acre (pounds).	Number of grains of seed in 1 gram.	Number of seed per head.
		1907.	1907.	1907.		*Ft. in.*			1908.					
C	Saraup	July 13	July 24	Sept. 12	3½	1 0	43,560	152,460	Feb. 1	614	3,420	17,736	52.40	249
B	Radin	do	do	Sept. 4	3½	1 6	19,360	67,760	Jan. 17	542	2.966	13,424	44.74	200
E	do	do	do	Sept. 6	3½	1 0	43,560	152,460	Jan. 19	492	2,714	15,746	49.91	206
D	do	do	do	Sept. 16	3½	9	77,440	274,040	do	504	2,786	11,244	46.62	211
A	do	do	do	Sept. 3	3½	6	174,240	609,840	Jan. 15	480	2,678	23,820	41.13	130
F	do	do	do	Sept. 9	1	6	148,464	148,464	Jan. 19	516	2,834	15,838	47.50	190
G	do	do	do	Sept. 5	2	9	77,440	154,880	Jan. 21	442	2,422	17,784	44.87	191
H	do	do	do	Sept. 6	5	1 2	32,003	160,015	do	502	2,782	18,650	49.71	210

COFFEE.

The acreage under coffee has increased a little, there being 10,833 acres last year as compared with 9,708 at the end of 1906. A large acreage of coffee is continually being killed out by the rubber trees, with which it has been interplanted, growing up and shading the coffee bushes so that they do not grow vigorously and only struggle in producing less and less fruit. Selangor possesses 75 per cent of the whole acreage. The crops have been on the whole good, but the figure of acreage crop is not of any value as a great deal of coffee growing under rubber and yielding little or no fruit is included.

TAPIOCA.

The cultivation of tapioca (*Manihot utilissima*), which occupies about 10,000 acres in the Federated Malay States, and more than double that area in the Straits Settlements, continues to give large returns to the careful planter. The tapioca plant is especially free from disease of leaf, stem or root, and its temporary cultivation makes it possible, should any pest attack it to destroy the affected plants and thus prevent the spread of the disease. During last year experiments were carried out to show the relative effect of different manures on tapioca, the results of which will appear in a future report. An investigation is being carried on in the scientific laboratories at Buitenzorg into the varieties of tapioca used in cultivation, and at the request of Dr. Treub specimens were sent from Malaya to be examined and experimented with.

RUBBER IN MALAYA.

The rapid progress of the rubber industry in Malaya continued during 1907, and at the end of that year 45,764 more acres of rubber land had been planted, an increase of about 46 per cent on the total of the previous year. The number of acres of planted rubber on the 31st of December, 1907, being 179,227. The number of trees in 1906 was under 13,000,000, and in 1907 27,558,400, a large acreage being planted closer than before.

The output of dry rubber increased by 144 per cent; 1907 showing an export of 2,278,870 pounds, or 1,017 tons, as against 936,056 pounds, or 417 tons, in the previous year. More than seven times the amount of rubber was exported in 1907 than two years before in 1905.

Rubber statistics in Malaya up to the 31st of December, 1907.

Item.	Federated Malay States.	Straits Settlements and Kedah.	Johore.	Total.
Number of estates	287	65	13	365
Acreage in possession	412,210	116,549	96,849	625,608
Acreage planted up to 31st of December, 1907	126,235	42,866	10,126	179,227
Acreage planted during 1907	40,473	9,344	5,764	55,581
Number of trees planted up to 31st of December, 1907	19,628,957	6,787,216	1,142,196	27,558,369

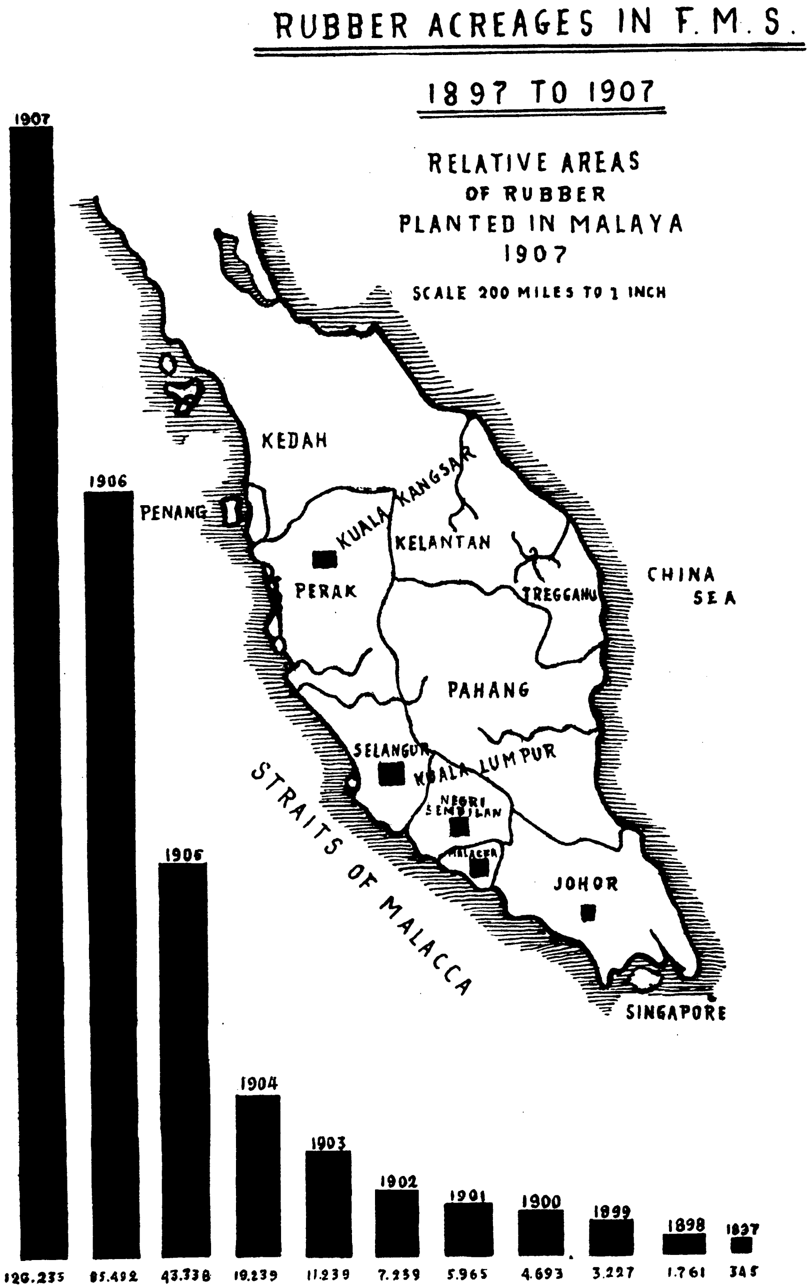

PLATE II. MAP AND CHART SHOWING TEN YEARS' GROWTH OF THE RUBBER-PLANTING INDUSTRY IN THE FEDERATED MALAY STATES.

RUBBER IN THE FEDERATED MALAY STATES.

At the end of 1906 there were in the Federated Malay States 85,000 acres, at the end of last year 124,580, an increase of about 46 per cent. There were 10,745,000 trees planted in 1906, and nearly 20,000,000 in 1907. The output of dry rubber was nearly doubled, showing 1,028,792 pounds, or 459 tons, in 1906, and 1,984,285 pounds, or 885 tons, in 1907, an increase of 93 per cent. Since January, 1906, the amount of rubber planted has been trebled, and the whole of that large acreage is in a healthy and vigorous condition.

Comparative table of rubber acreage and trees in Malaya, 1906 and 1907.

District.	Rubber acreage.		Number of trees.	
	1906.	1907.	1906.	1907.
Federated Malay States:				
Selangor	44,821	61,552	5,477,390	9,648,093
Perak	29,612	46,167	3,990,462	6,648,957
Negri Sembilan	10,663	17,656	1,196,150	3,165,388
Pahang	483	860	81,000	166,590
Straits Settlements:				
Malacca	[a]28,784	36,946	[a]472,056	6,019,946
Province Wellesley	4,738	5,920	615,940	767,276
Johore	4,362	10,126	[a]492,906	1,142,196
Total	123,463	179.227	12,325,904	27,558,446

[a] These figures are approximate.

In Province Wellesley is included one estate in Singapore, one estate in Penang and one in Kedah.

TEN YEARS OF RUBBER PLANTING IN THE FEDERATED MALAY STATES.

The history of rubber planting in the Federated Malay States is probably unique in the rapidity with which a new cultivation, found to be specially suited to the climate, has been established. The black columns on the chart show only the Federated Malay States acreages and do not include Malacca, Johore, and Province Wellesley. The progress of these places has, however, been approximately the same.

In 1897, rubber estates were less than 350 acres in extent, ten years after they had increased 360 times. In 1902 less than 7,500 acres had been planted; five years after 17 times that amount was under rubber. Nearly all of this land was virgin jungle previous to its being planted with rubber and had to be cleared before any planting operations could be begun. Nine-tenths of the whole acreage has been cleared and planted by the younger generation of planters, who deserve the greatest credit for the excellent way in which their work has been carried out. The difficulties under which most of them have opened up their estates have been many and varied: bad conditions of health, both for master and coolie, and steadily rising prices for labor owing to local conditions.

YIELDS OF DRY RUBBER PER TREE.

The average amount of dry rubber is, over the whole peninsula, 1 pound 12 ounces per tapped tree, exactly the same figure as was recorded for last year. This is most encouraging, as the number of trees which are being tapped for the first time far exceeds those already tapped, especially in Selangor, where the average is 1 pound 7 ounces per tapped tree.

Experiments are being carried on in various parts of the Peninsula—Perak, Selangor and Negri Sembilan—in regard to yields of comparatively old trees which have not previously been tapped. In Krian these experiments have been carried out for nearly four months, only half the tappable area of the trees being used and space being left so that more than three years will elapse, with continuous tapping every other day, before the healed surface will be reached again. The figures for one year will be published in next year's report, but as far as they have gone the yields average more than 2 pounds per tree a month.[1] The trees are planted widely apart round the edges of a graveyard and are about 17 years old.

There is as yet not sufficient evidence as to what yields may fairly be expected over large areas of trees from 10 to 20 years old, but all the data which we have at present points to the fact that estimates or prophecies of probable yields at these ages will be amply confirmed.

Comparative table of rubber crops in Malaya, 1906 and 1907.

District.	Number of trees tapped.		Rubber yields (pounds).		Average yield per tree, 1907.	
	1906.	1907.	1906.	1907.		
Federated Malay States:					*Lb.*	*Oz.*
Selangor	364,638	772,656	620,033	1,131,086	1	7½
Perak	67,710	132,556	94,848	272,804	2	1
Negri Sembilan	91,410	240,401	146,891	586,864	2	7
Pahang						
Straits Settlements:						
Malacca	[a]7,000	12,455	[a]12,000	23,490	1	14
Province Wellesley	20,076	48,000	[a]13,560	82,131	1	11
Johore	48,350	94,159	47,724	182,495	1	15
Total	599,184	1,300,227	935,056	2,278,870	1	12

[a] These figures are approximate.

In Province Wellesley is included one estate in Singapore, one estate in Penang and one in Kedah.

OVERPRODUCTION AND SYNTHETIC RUBBER.

The fear of overproduction which appeared very large a year or more ago has, owing to more accurate knowledge of the world's demand for rubber and the amount produced, to some extent subsided. The drop in prices, while having the effect of reducing the amount of rubber

[1] This is probably an error and the author means 2 lbs. a year. (Editor.)

planting, may also to a great extent reduce the output from Brazil, where the margin of profit is much less than in cultivated rubber.

This also should lead not only to a consideration of cheapening of methods of production, but to the possibilities of increasing the demand for rubber. No product lends itself more to measures for improving and widening the market. The almost endless possibilities for the economic use of rubber, and the small proportion of the purchasing population of the world which at present knows and uses rubber, both demonstrate the fact that measures taken to provide new outlets for rubber are much more hopeful than in the case of food or textile products like coffee or copra, which have a comparatively limited number of uses.

It is not to the interest of cultivated rubber that the output of the Brazilian product should decrease very rapidly. There is not yet sufficient cultivated rubber or wild rubber from other sources to supply the increasing demand. Those who look forward to a future for immense areas of cultivated rubber in suitable climates, of which the Malay Peninsula can claim to be the best, believe that cultivated rubber will in time satisfy all the manufacturers in regard to its physical qualities and will be produced in sufficient quantity to meet the world's requirements. It is not easy to foresee the future demands for rubber, but a substance which has made itself so indispensable to all civilized races must be required in increasing quantities, and the fear of overproduction may be canceled, by the quite as likely possibility of the supply not meeting the demand and the consequent resort to other substances as substitutes for rubber.

IS CLEAN WEEDING ADVISABLE.

Weeding on most of the rubber estates in the Federated Malay States is the item costing most annually. This sum is spent on labor, and represents in many cases 70 per cent or more of the total labor of the estate.

The object of the rubber planter is to obtain as quickly as he can vigorous trees of as large a girth as possible, at the smallest cost, and in order to effect this he keeps his fields as clear of weeds as possible and so allows the rubber tree to have all the moisture and plant food available in the soil.

That clean weeding will show a better result in the growth of the rubber trees than allowing all and any weeds to grow continuously, can no doubt be proved. In Perak, however, some of the estates from want of money or shortness of labor have not been able to keep their plantations clear of weeds and have abandoned weeding. In some cases the weeds are checked by being regularly cut, but in others nothing at all has been done to eradicate or discourage the weeds.

The growth of trees on such places is somewhat poorer than trees in

similar condition which have been kept free from weeds, but the vigor and girth of the trees where the weeds have been allowed to grow is not so markedly different as the disciples of clean weeding would expect to see.

The belief in clean weeding is a tradition handed down from English farming to tea and coffee planting in the East; good farming is associated with absence of weeds. In Europe, the farmer of cereals and other crops does not practice the method of using certain plants as a substitute for weeds. There are various reasons why clean weeding in such crops is a good policy in Europe, but annual crops have to be treated differently from permanent cultivations, and the conditions of labor, cultivation, plant growth and especially climate are entirely different in the tropics from those in temperate climates and consequently methods have to be modified.

The objections to clean weeding in rubber cultivation in the Federated Malay States and removal of all protection from the surface of the soil are that it allows a large amount of percolation of heat radiation and of evaporation of moisture, also that heavy rainfall on all but flat surfaces always results in the constant removal of very large quantities of top soil, which are either carried away in streams or transferred to the drains. It is not easy to estimate the loss that takes place in tropical climates where the soils are allowed to remain exposed and frequently scraped. An immense amount of plant food is continually lost through percolation and drainage; the greater part of this is absorbed by the roots of any plants growing on the surface; and when the leaves and stems of these plants are cut this is to a great extent returned to the soil.

With the soil protected from the rays of the sun the conditions of moisture and temperature are most favorable to the development of bacteria which are responsible for the liberation of plant food. In clean weeded land the top 2 inches or more of soil are, because of admission of heat and light, made impossible for feeding roots and the preparation of food for them. When the ground is covered this surface layer is kept moist and useful for the feeding roots. A considerable area is thus added to the area of soil available for rubber roots and the growth of the trees is improved.

In addition to arguments for clean weeding there is a local one, the danger of the ground being taken possession of by "lalang" (*Imperata arundinacea*), a pestilent weed, which once allowed to invade a plantation can only be eradicated at enormous expense. This plant is ubiquitous, is always one of the first to cover newly opened land, and by far the most difficult weed to eradicate.

The experience gained in the use of tapioca as a catch crop in rubber, which obtains on some thousands of acres of rubber showing excellent growth, is another argument in favor of keeping the soil covered up. Few, if any, crops take more from the soil than tapioca, but this loss

of valuable plant food in the soil is to a great extent compensated for by the advantage of keeping the soil from the sun and rain. The girths of young rubber trees grown with tapioca are in many cases as large as those of trees in similar land, clean weeded, and without any other crops.

Though figures of cost of weeding vary very greatly, on some estates the cost two years after the land has been opened is not under \$2 per acre, per month, or \$24 a year. This represents on an estate of 1,000 acres a cost of \$24,000 per year, and a probable cost for weeding of nearly \$100,000 before the rubber is in bearing. In labor it represents a continual force of about 250 coolies working for three hundred days in the year.

I have for the last three years been investigating the question of a substitute for weeds which will reduce the wage bill without reducing the rapidity with which the rubber trees grow, and mentioned in my annual report for last year three plants which observation and experiment show to be suitable and therefore worth a serious trial on every estate. These three plants belong to the order Leguminosae, the clover, pea and crotaloria tribe, a group of plants many of which are characterized by the possession of bacteria on their roots. These bacteria, the life history of which has been investigated fully by a large number of botanists and agriculturists, live in what is technically called symbiotic relationship; i.e., both host plant and bacterium being of mutual service to each other. In a report of this character it is unnecessary to more fully explain this point, but it will suffice to say that the bacteria which form characteristic nodules on the roots of the host plant, take nitrogen from the air, and this nitrogen is afterwards available in the soil as plant food. The amount of nitrogen thus added to the soil varies with the species of the bacteria and their numbers, but in the case of one of the plants hereafter mentioned experiments have shown it to be as much as 200 pounds per acre a year.

The three plants which seem to me most suitable in Malaya for the purpose above mentioned are: I, *Crotalaria striata;* II, *Mimosa pudica;* III, *Desmodium triflorum.*

I. *Crotalaria striata* is a quick-growing vetch-like plant with trifoliate darkish green leaves. In good soil with sufficient rainfall it grows to a height of 6 feet in about a year. When sown sufficiently thick it completely covers the ground within a few weeks, so that the clearing is like a good lucerne or vetch crop in Europe, and the surface of the ground is not seen at all.

It has been proved by experiments with this plant in Ceylon that 14,000 pounds of organic matter were formed by crotalaria under cacao, and the nitrogen in this organic matter was equal to that in 1,700 pounds of castor cake or 700 pounds of nitrate of soda. Other plants—weeds—can not get enough light under the dense cover of the crotolaria, and

new weeds are kept out as their seeds can not reach the ground which is so well covered. If the crotalaria is sown in good growing weather, and if the land is clear of all weeds, no further weeding should be necessary, but in the case of land which is thoroughly permeated with the underground stems of lalang or with the roots of other weeds it may be found that during the first two or three months weeding is necessary. The crotalaria seed is sown broadcast. As to the quantity to be used per acre it is better to sow more than is necessary than to leave bare patches where weeds can thrive. Mr. Lauder Watson, who is the first Federated Malay States planter to use this plant in rubber planting, informs me that at Lauderdale he used about 7 pounds. I have seen good results from using only 4 pounds per acre.

II. *Mimosa pudica,* the "sensitive plant," which was another of the plants suggested in the last annual report, is in many ways the best of all plants to put down as a substitute for weeding. In many cases it has taken less trouble to establish this plant than crotalaria, and it thrives extremely well in the Malayan Peninsula on varying soils. The peculiar habit of shutting up its leaves when touched is in its favor. When rain falls at all heavily the leaves shut and the water reaches the soil at once, but when the sun shines again the leaves open up and protect the soil from the sun's rays. My experience of this plant is that while it grows well on sloping and dry land it seems to enjoy more moist conditions and can be seen in great vigor in ravines and flat places where the moisture is more abundant.

III. *Desmodium triflorum,* a small creeping shamrock-like clover, has the advantage that it grows only a few inches high and covers the ground with a turf easy and pleasant to walk on. It is, however, more difficult to establish, and as it seeds very sparingly, it is not easy to obtain any quantity of seed for planting. On one estate some 200 acres have been successfully laid down with this plant by taking it from neighboring waste land and planting it as soon as the land was cleared.

The question of the best method of establishing one or other of the substitutes for weeds or clean weeding is being experimented on both at the experiment plantations of this department and by various planters who are alive to the great advantages to be gained if they can cover their ground with a friendly plant. By far the best time to establish one of these plants at a minimum cost is directly after the land has been burned off. In virgin land after burning no seeds of herbacious plants are alive in the soil, and any seeds sown of plants planted have no competitors and quickly take possession of the soil. Having once got the plant established at the danger of lalang or other weeds gaining an entrance, the immediate necessity of putting the rubber in is over, since the fields do not get any worse, but rather better for the reception of the rubber plants and the cost of cutting away the crotalaria, mimosa or other plant to put in lines and holes is very little. Drains are not

necessary or even useful and thus another expense is saved. The only weeding necessary is in case jungle trees or shurbs sprout, and these can easily be noticed among the prevalent growth of a single plant and removed. No soil is lost from the begining of the opening of the land, and the gain in this to the roots of the rubber plant is not to be neglected.

RUBBER MACHINES.

The number of estates which have trees of sufficient growth for tapping is as yet not very many, but each year more become productive, and the question of the best and most economical machinery for preparing rubber for the market and for cleaning "scrap," "bark," and "earth" rubber is one of the most important in the profitable working of an estate.

Dr. Kuhleman, chemical adviser to one of the largest rubber manufactories in Germany, paid a visit recently to this country to acquaint himself with the methods of the planter in his preparation of rubber. He was impressed by the care which is universally taken to ensure the purity and cleanliness of the rubber sent home.

In asking his advice upon the plant used by the planter, Dr. Kuhleman informed me that one point which he noted was, that the washers and rollers, in use on estates were very short in length. This was the case in the beginning of the manufactories in Germany. Machines with narrow rollers were at first put up and then when these could not deal with, the amount of rubber required more were added, but it was soon found more economical to have one roller of 10 feet long than five of 2 feet. It will be well that planters should in making arrangements for their rollers and washers look ahead to the time when they are producing much larger quantities of rubber than at present. The machines at present in use are, for dealing with a large quantity of rubber, mere toys and will either have to be multiplied or larger machines put in.

The longer rollers have an advantage over the short ones, at present in use, in that the risk of oil reaching the rubber from the bearings as it passes through the rollers is decreased. Rubber prepared in a number of small-length machines will be in more danger of being discolored at places than that prepared in fewer and longer rollers. The length of rollers in rubber-washing machines used in factories in Europe is often 12 feet, whereas, as a rule on estates in the Federated Malay States, two or more rollers of not more than a foot in length are often used.

PREPARATION OF RUBBER FOR THE MARKET.

Block rubber, the advantages of which for packing, transportation and preservation are undoubted, has not commended itself generally to the planter. Until large quantities of any of the forms of rubber produced in Malaya, viz, block, crêpe, and sheet, are put on the market, it will not be possible to settle the much-vexed question as to the advantages of each. The sale at a big price, of a shipment of any of these forms, at

once produces the impression that that special form is more attractive to buyers and will command better prices, but it should be remembered that the quality of the rubber as well as the shape in which it is sent is a factor, and the most important factor, in determining its market value. In whatever form it is sent it is of the most vital importance that planters should continue to aim at the purest and cleanest rubber. The manufacturers have begun to realize the advantages of the freedom from impurities which Eastern plantation rubber possesses, and this good opinion is too valuable to be endangered by using less care in preparation.

RUBBER SEED FOR OIL MANUFACTURING PURPOSES.

Rubber seed, both with the husk on and decorticated, has been sent to the Imperial Institute and to various commercial firms dealing in such products in Europe and Australia in order to introduce this article to them with a view to a future market.

The oil from the seed is a drying oil not unlike linseed oil in appearance and smell, and probably will prove as good as, it not better than, the latter oil in manufacture of paints and varnishes. Manufactures or dealers wishing to have samples of the seeds either decorticated or in the shell should communicate with this department. A profit per acre after paying all expenses of picking, husking, packing and shipping of at least $5 to $8 may be earned on estates with trees in full fruit bearing. While the demand for considerable quantities of seed for planting purposes continues, this method of disposing of seed is very much more profitable than the sale for oil, but with an immense number of trees producing fruit the supply for planting purposes will soon greatly exceed the demand and an additional market is needed. If the seeds are left on the ground they germinate freely and money must be spent in weeding out the young plants.

The questions in regard to the best methods of preparation and packing of the seed in exporting it for oil purposes continue to engage the attention of the department of agriculture, and a further report will be issued.

AGRICULTURAL NOTES.

GENERAL CONDITIONS.

The weather.—There was but little change in the prevailing weather conditions during the month of March and the drought which is general and a regular occurrence at this season of the year caused appreciable damage to crops of rice, corn and tobacco in some towns of Batangas, Bohol, Cagayan, Cebu, Ilocos Sur, Isabela, Lepanto Bontoc, Leyte, Occidental and Oriental Ngeros, and Samar. Reports from Bucay in Ilocos Sur, Moncada in Tarlac, San Nicolas in Ilocos Norte, Calolbon in Albay, Danao in Cebu, and Antequera in Bohol, state that there was a steady drought but at the time reported no serious damage had been done. According to reports from our correspondents in Oslob and Asturias in Cebu, the corn and tobacco crops were suffering most from the drought. The same report was received from the towns of Janiway in Iloilo, Manawag in Pangasinan, and San Luis in Pampanga.

From the above reports it would seem that agricultural crops generally do well at this season only in comparatively few sections where the lands are irrigated. On the other hand, in a few sections the land was in a good state of cultivation, crops were in a flourishing condition and if weather conditions continue favorable good harvests are sure to be gathered. Such reports were received from Sagnay in Ambos Camarines, Mariveles in Bataan, Santa in Ilocos Sur, Dapa in Surigao, Tayasan in Oriental Negros and several other places. In Tandag, Surigao, recent showers were taken advantage of for a second planting of rice. Excessive rains which were doing considerable damage to crops of rice and corn were reported from San Francisco de Malabon in Cavite, Catarman in Samar, Baybay and Macrohon in Leyte.

Rats and locusts.—Crops of palay and sugar cane in Bacon, Sorsogon, and Himamaylan in Occidental Negros are reported to have been damaged considerably by rats and locusts. In other places it is reported that rats have done considerable damage in the rice fields, though according to the reports sent to us the damage was much less than it was several months ago. During the last week in March small swarms of locusts were reported on some of the sugar cane plantations in the towns of Bacolod, Murcia and Cadiz in Occidental Negros; however, fortunately but little damage was done.

Farm help:—From several places throughout the provinces the lack

of farm help has been repeatedly reported as interfering with the necessary work of harvesting. Such a situation has been emphasized by our correspondent at Danao on the Island of Cebu, which condition is doubtless due to the employment of many laborers on the Philippine Railway. In Mindanao, and particularly in Davao, a considerable portion of the harvests has gone to waste because of a lack of farm laborers, and this situation must be met if farming is conducted on a large scale as seems to be the desire of the Mindanao planters.

Animal diseases.—In Himamaylan, Occidental Negros, rinderpest was reported as disappearing and foot-and-mouth disease as having been completely stamped out. Cattle disease was reported as having reappeared in Tanauan, Leyte, Binmaley in Pangasinan, and Ibaan in Batangas. In the first two municipalities the reappearance of the disease was owing to carelessness and the neglect of precautions which should have been taken in the case of all suspicious animal diseases. In these towns no isolation or quarantine of the animals was maintained to prevent the spread of the disease. Rinderpest was also reported from the municipalities of Tayum in Ilocos Sur, Caloocan in Rizal, Navas in Capiz, Cabatuan in Iloilo, and a few other towns. The veterinarians of this Bureau are inoculating cattle as fast as they can reach the infected sections and the results of their work are decidedly encouraging, as there seems to be a great decrease in the number of animals infected. It is hoped that this disease may be stamped out in the near future.

CROPS.

Abacá.—The decrease in the price of hemp is discouraging to planters and many of them are preparing their lands for planting other crops with the hope of regaining the losses incurred through growing abacá. From Cabadbaran in Agusan abacá planting is reported as being abandoned, half of last season's crop having been lost. According to our correspondent there, one kilo of abacá costs ten centavos while in Ambos Camarines the price of a picul varies between ₱5 and ₱6. From other sections where hemp has been the staple crop it is now reported as of secondary importance because of the prevailing low price and the small demand for even inferior grades, so that hemp planters are being compelled to turn their attention to crops which yield better returns.

Our correspondent from Pilar, Sorsogon, reports that "pacol," an inferior grade of hemp, is one of the most important local products and that 280 piculs of this fiber were marketed during the month of March at ₱4.50 per picul while the price of hemp in the same locality is ₱6.50 per picul.

Sugar.—The sugar crop is reported as being very satisfactory in sections where sugar cane is grown. Abundant crops are reported as harvested in La Carlota, Occidental Negros, Nasugbu in Batangas, Morong in Rizal, and Santa Cruz in Laguna. The milling of sugar cane

has been intermittent in some sections on account of scarcity of labor. In Danao, Cebu, it is stated that so much land has been planted to sugar cane that it is thought to have considerably lessened the amount planted to corn.

While the grinding of sugar cane continues, in many places the fields are being prepared for a new crop. Fair harvests of this product are reported from Balayan, Batangas. In most places all of the sugar cane has been harvested although in some places there are a few fields which have not yet been gathered.

Our correspondent from San Nicolas, Ilocos Norte, reports that during February and March 10,300 tinajas of *basi* and 3,900 piculs of molasses were sold at ₱2 a tinaja for *basi* and ₱3 a picul for molasses.

Rice.—A good crop of rice is reported as harvested in Candaba, Pampanga, Santa Rosa and Siniloan in Laguna, Quiangan in Nueva Vizcaya, and Gapan in Nueva Ecija. Fair sized copras were also harvested in San Rafael, Bulacan, Tanawan in Leyte, Biñan in Laguna, and Antequera in Bohol. In the towns of Batangas, Bohol, Cagayan, Capiz, Cebu, Ilocos Sur, Isabela, Lepanto-Bontoc, Leyte, Occidental and Oriental Negros and Samar the rice crop was reported as considerably damaged by the drought.

Coconuts.—The coconut crop is reported from many municipalities as being in a flourishing condition. The coconut trees in Siniloan, Laguna, Janiway in Iloilo, Calolbon in Albay and Mariveles in Bataan were reported as promising an excellent harvest.

Corn and tobacco.—The corn and tobacco crop as previously stated seems to have suffered most from the present drouth. A good quantity of corn is reported as harvested in Magsingal, Ilocos Sur, Bodian in Cebu and in several other municipalities. A large crop of corn was harvested in the municipality of Antequera in Bohol. During the month of March preparation was being made for the first planting of corn and the second planting of *palay*.

Our correspondent from Libmanan, Ambos Camarines, states that "ikmó" leaves (*Piper betle*) command a good price, that they are more extensively cultivated there than in any other part of that section of the country, and that this one town supplies all of the towns in the Provinces of Albay and Ambos Camarines.

The correspondent from Bacon, Sorsogon, informs us that 18,000 pounds of ylang-ylang which was selling for five centavos per pound had been collected.

CROPS PLANTED AND HARVESTED AND CONDITION OF SAME TAKEN FROM MONTHLY CROP REPORTS FOR THE MONTH OF FEBRUARY, 1909.

[RICE.—This article is in the unhulled state.]

Province and crop.	Condition.	Planted during month.	Harvested during month.		
			Area.	Quantity.	Unit.
Agusan (reports from 3 towns):		*Hectares.*	*Hectares.*		
Rice	Good	120			
Abaca	do	8	15	689	Piculs.
Coconuts	do			30,000	Nuts.
Corn	do			70	Cavans.
Albay (reports from 12 towns):					
Rice	do	37	615	7,110	Do.
Abaca	do	79	1,907	7,265	Piculs.
Coconuts	do			639,800	Nuts.
Corn	do	72	20	90	Cavans.
Ambos Camarines (reports from 27 towns):					
Rice	do	67	1,757	28,794	Do.
Abaca	do	273	6,220	26,977	Piculs.
Coconuts	do			977,000	Nuts.
Sugar cane	do	15	10	12	Piculs.
Antique (reports from 8 towns):					
Sugar cane	do	382	251	4,015	Do.
Coconuts	do			7,000	Nuts.
Abaca	do		4	47	Piculs.
Corn	do	114	2	8	Cavans.
Bataan (reports from 6 towns):					
Rice	Fair	28	735	6,862	Do.
Sugar cane	do	193	130	6,650	Piculs.
Corn	do	2		21	Cavans.
Coconuts	do				
Batangas (reports from 12 towns):					
Rice	Good		20	240	Do.
Sugar cane	do	1,270	1,468	33,884	Piculs.
Corn	Fair	70	618	2,430	Cavans.
Abaca	do		17	34	Piculs.
Benguet (reports from 8 towns):					
Rice	do	41			
Sugar cane	do				
Coffee	do				
Bohol (reports from 24 towns):					
Rice	do	330	75	1,000	Cavans.
Abaca	Good	19	104	417	Piculs.
Coconuts	do			1,923,000	Nuts.
Corn	Fair	1,360	202	3,879	Cavans.
Bulacan (reports from 13 towns):					
Sugar cane	Good	723	2,160	2,215	Piculs.
Corn	do	10	2		
Rice	do	10	10,332	221,970	Cavans.
Tobacco	Fair	3			
Cagayan (reports from 11 towns):					
Tobacco	do	1,023			
Corn	Good	763			
Coconuts	do			8,000	Nuts.
Rice	do		950	6,530	Cavans.
Capiz (reports from 15 towns):					
Sugar cane	do	37	26	962	Piculs.
Coconuts	do			123,000	Nuts.
Corn	do	47			
Abaca	do	49	117	498	Piculs.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of February, 1909—Continued.

Province and crop.	Condition.	Planted during month.	Harvested during month. Area.	Quantity.	Unit.
Cavite (reports from 6 towns):		*Hectares.*	*Hectares.*		
Sugar cane	Good	366	447	10,515	Piculs.
Corn	do	5	35	615	Cavans.
Rice	do		2,300	38,000	Do.
Coconuts	Fair			45,000	Nuts.
Cebu (reports from 30 towns):					
Coconuts	Good			716,000	Do.
Corn	Fair	2,111	19,565	233,957	Cavans.
Rice	Good	175	399	3,975	Do.
Ilocos Norte (reports from 10 towns):					
Rice	Fair		6,171	92,590	Do.
Sugar cane	Good	239	632	610	Piculs.
Tobacco	do	231	243	2,160	Quintals.
Maguey	do	40	10	100	Piculs.
Ilocos Sur (reports from 19 towns):					
Sugar cane	do	626	482	7,090	Do.
Tobacco	do	78	30	151	Quintals.
Corn	do	1,169	125	728	Cavans.
Maguey	Fair	6	296	2,722	Piculs.
Iloilo (reports from 15 towns):					
Sugar cane	Good	446	528	132,070	Do.
Coconuts	do			31,000	Nuts.
Rice	do		4,200	43,000	Cavans.
Corn	do	527	45	100	Do.
Isabela (reports from 4 towns):					
Tobacco	Fair	346	29	252	Quintals.
Corn	do	95			
Rice	do				
La Laguna (reports from 20 towns):					
Coconuts	do			2,258,000	Nuts.
Abaca	Good	6	680	728	Piculs.
Sugar cane	Fair	3	260	12,050	Do.
Rice	do	1,167	2,241	57,850	Cavans.
La Union (reports from 11 towns):					
Tobacco	Good	1,163	61	469	Quintals.
Corn	do	14	6	24	Cavans.
Sugar cane	Fair	74	135	2,930	Piculs.
Coconuts	Good			79,000	Nuts.
Lepanto-Bontoc (reports from 15 towns):					
Tobacco	Fair	23	4	59	Quintals.
Sugar cane	Good	16	41	340	Piculs.
Rice	Fair	513	101	337	Cavans.
Corn	Good	160	62	273	Do.
Leyte (reports from 18 towns):					
Abaca	Fair	184	5,078	13,634	Piculs.
Coconuts	Good			1,248,000	Nuts.
Corn	do	517	391	6,080	Cavans.
Rice	do	449	332	8,820	Do.
Misamis (reports from 4 towns):					
Abaca	Fair	24	135	985	Piculs.
Coconuts	do			439,000	Nuts.
Sugar cane	Good		4	160	Piculs.
Corn	Fair		20	150	Cavans.
Moro Province (reports from 9 towns):					
Coconuts	Good			91,000	Nuts.
Corn	do		3	142	Cavans.
Abaca	do	12	164	1,306	Piculs.
Rice	do	95			
Nueva Ecija (reports from 16 towns):					
Rice			7,785	187,125	Cavans.
Sugar cane	do	118	15	650	Piculs.
Tobacco	Fair	51	35	150	Quintals.
Corn	do	15	7	16	Cavans.
Nueva Vizcaya (reports from 4 towns):					
Rice	Good				
Tobacco	Poor				
Sugar cane	Good				
Occidental Negros (reports from 14 towns:)					
Sugar cane	do	4,489	23,987	165,310	Piculs.
Coconuts	do			198,000	Nuts.
Abaca	Fair	55	35	139	Piculs.
Corn	do	323	200	2,000	Cavans.

Crops planted and harvested and condition of same taken from monthly crop reports for the month of February, 1909—Continued.

Province and crop.	Condition.	Planted during month.	Harvested during month.		
			Area.	Quantity.	Unit.
Oriental Negros (reports from 15 towns):		*Hectares.*	*Hectares.*		
Abaca	Good		192	1,799	Piculs.
Coconuts	do			1,192,000	Nuts.
Corn	Fair	72	165	4,690	Cavans.
Sugar cane	do	105	105	3,855	Piculs.
Palawan (reports from 2 towns):					
Coconuts	Good			1,031,000	Nuts.
Maguey	do				
Cacao	Excellent				
Pampanga (reports from 7 towns):					
Rice	Good	13,000			
Sugar cane	do	3,340	2,470	12,510	Piculs.
Corn	do	60			
Pangasinan (reports from 33 towns):					
Sugar cane	Fair	1,579	1,267	8,065	Do.
Coconuts	do			339,000	Nuts.
Corn	Good	466	428	2,145	Cavans.
Tobacco	do	506	361	1,501	Quintals.
Rizal (reports from 14 towns):					
Sugar cane	do	207	116	576	Piculs.
Abaca	do				
Rice	do		39	3,011	Cavans.
Corn	Fair	54			
Samar (reports from 21 towns):					
Rice	do	510	513	1,070	Do.
Abaca	do	92	1,032	5,368	Piculs.
Coconuts	do			263,000	Nuts.
Corn	Good	48	15	150	Cavans.
Sorsogon (reports from 18 towns):					
Rice	do	1,532			
Abaca	do	509	7,283	16,156	Piculs.
Coconuts	do			143,000	Nuts.
Corn	Fair	37	46	405	Cavans.
Surigao (reports from 6 towns):					
Rice	Good	800			
Abaca	Excellent	3	189	1,868	Piculs.
Coconuts	Good			20,000	Nuts.
Sugar cane	do	3	4	8	Piculs.
Tarlac (reports from 8 towns):					
Sugar cane	Fair	677	3,087	5,800	Do.
Tobacco	do	46	107	335	Quintals.
Rice	Good	400	5	17,100	Cavans.
Corn	do		10	100	Do.
Tayabas (reports from 15 towns):					
Rice	do	2,363	707	728	Do.
Coconuts	Fair			1,959,000	Nuts.
Abaca	Good	121	399	1,190	Piculs.
Corn	do	30	11	110	Cavans.
Zambales (reports from 8 towns):					
Sugar cane	Fair	62	49	370	Piculs.
Coconuts	Good			15,000	Nuts.
Corn	Fair	4			
Maguey	do		5	60	Piculs.

RANGE OF PRICES OF PHILIPPINE AGRICULTURAL PRODUCTS.

Highest and lowest prices of rice, abaca, copra, sugar, tobacco, and corn for the month of February, 1909.

Province.	Rice (unhulled) per cavan.		Abaca per picul.		Copra per picul.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
Agusan	₱3.50	₱2.00	₱7.00	₱4.00	₱7.00	₱7.00
Albay	3.75	2.00	9.00	4.00	6.50	4.75
Ambos Camarines	4.60	2.00	11.50	4.00	7.00	4.50
Antique	3.00	1.50	18.00	6.00	6.50	3.25
Bataan	2.50	2.00			4.00	4.00
Batangas	3.50	2.00	10.00	4.00		
Benguet	5.00	4.50				
Bohol	3.75	3.00	18.00	5.25	8.00	5.50
Bulacan	2.50	2.00				
Cagayan	3.75	2.25			5.50	5.50
Capiz	3.25	1.60	20.00	5.00	7.00	5.00
Cavite	2.60	2.40	17.00	17.00	7.00	7.00
Cebu	4.50	2.25	27.00	10.00	9.00	4.00
Ilocos Norte	5.50	3.00				
Ilocos Sur	5.00	2.50				
Iloilo	4.50	1.50	20.00	14.00	8.00	4.00
La Laguna	3.50	1.40	17.00	6.40	6.50	5.00
La Unión	4.50	3.00			8.00	3.00
Lepanto-Bontoc	5.00	3.00				
Leyte	4.00	2.50	13.50	4.50	10.00	4.00
Misamis	3.30	2.50	11.00	7.00	7.50	7.00
Moro	5.00	2.00	16.00	7.00	7.75	5.50
Nueva Ecija	3.50	1.25			4.00	4.00
Nueva Vizcaya	1.50	1.25				
Negros Occidental	3.00	2.50	15.00	11.00	8.60	5.00
Negros Oriental	5.00	2.50	14.00	6.00	8.50	6.00
Palawan	3.00	3.00			5.50	5.00
Pampanga	2.25	2.00	5.00	5.00		
Pangasinan	4.00	1.75			8.00	5.00
Rizal	2.75	2.25	18.00	18.00		
Samar	3.75	3.00	14.00	9.00	8.00	4.50
Sorsogon	3.75	2.50	14.50	4.50	7.00	5.00
Surigao	3.50	2.50	12.50	9.00	7.50	6.00
Tarlac	3.75	1.50				
Tayabas	5.00	3.00	15.00	4.50	6.50	4.25
Zambales	4.00	1.50			10.00	2.50

Highest and lowest prices of rice, abaca, copra, sugar, tobacco, and corn for the month of February, 1909—Continued.

Province.	Sugar per picul.		Tabacco, per quintal.		Corn per cavan.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
Agusan					₱2.25	₱2.00
Albay	₱6.00	₱6.00			1.50	1.50
Ambos Camarines	4.00	3.00			2.50	2.50
Antique	3.75	3.00			1.50	1.50
Bataan	6.00	5.00			2.00	1.50
Batangas	4.12	2.50	₱8.00	₱5.00	3.00	2.00
Benguet	6.00	3.00				
Bohol	5.00	4.00	25.00	25.00	5.00	2.50
Bulacan	7.00	5.75	20.00	12.00	3.00	1.50
Cagayan	4.00	4.00	10.00	8.00	4.00	2.40
Capiz	7.00	5.00				
Cavite	4.20	3.50			3.00	2.25
Cebu	5.50	2.00	40.00	4.50	4.80	2.50
Ilocos Norte	8.00	1.50	18.00	4.00	3.00	2.50
Ilocos Sur	6.00	2.50	60.00	3.00	5.00	1.00
Iloilo	6.00	3.00	40.00	5.00	4.00	2.00
La Laguna	6.50	3.00			3.00	2.50
La Union	4.50	3.00	8.00	7.00	2.00	2.00
Lepanto-Bontoc	6.00	2.50	4.00	4.00	5.00	3.00
Leyte	6.00	3.00	40.00	15.00	4.00	1.75
Misamis	4.00	4.00			3.50	2.50
Moro	5.25	3.00			3.00	1.50
Nueva Ecija	7.00	2.50	20.00	4.00	2.50	1.00
Nueva Vizcaya			5.00	5.00	1.50	1.50
Negros Occidental	4.90	3.43	8.50	3.50	2.80	2.50
Negros Oriental	5.00	4.00	30.00	4.00	5.00	2.50
Palawan			20.00	20.00		
Pampanga	5.50	4.00			2.60	2.60
Pangasinan	6.50	2.50	10.00	2.00	3.00	1.50
Rizal	4.50	3.50			5.00	2.25
Samar	5.00	5.00	35.00	20.00	2.50	2.50
Sorsogon	2.50	2.50	14.00	12.00	4.00	1.50
Surigao	4.00	4.00			2.60	1.50
Tarlac	5.25	2.00	8.00	4.00	5.00	1.25
Tayabas	4.25	3.00	6.00	6.00	5.00	3.00
Zambales	5.00	3.00	25.00	12.00	5.00	2.00

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PERIODICALS RECEIVED IN THE LIBRARY OF THE BUREAU OF AGRICULTURE.

ENGLISH.

GENERAL.

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